Knowledge.

With which is incorporated Hardwicke's Science Gossip, and the Illustrated Scientific News.

A Monthly Record of Science.

Conducted by Wilfred Mark Webb, F.L.S., and E. S. Grew, M.A.

JULY, 1912.

THE KALEIDOGRAPH.

By E. WILFRED TAYLOR.

THE Kaleidograph is, as its name implies, a machine by means of which very beautiful and complex designs may be drawn by the simple process of turning a handle.

In the space at our disposal it is quite impossible to give more than the briefest description of the design and construction of the machine, or of the many adjustments and alterations which may readily be made and by means of which the character and complexity of the designs are rendered almost limitless.

Briefly, the machine consists of three parts, each of which supplies some form of motion. These motions, when brought together by means of a pantograph, produce the designs with which this article is illustrated.

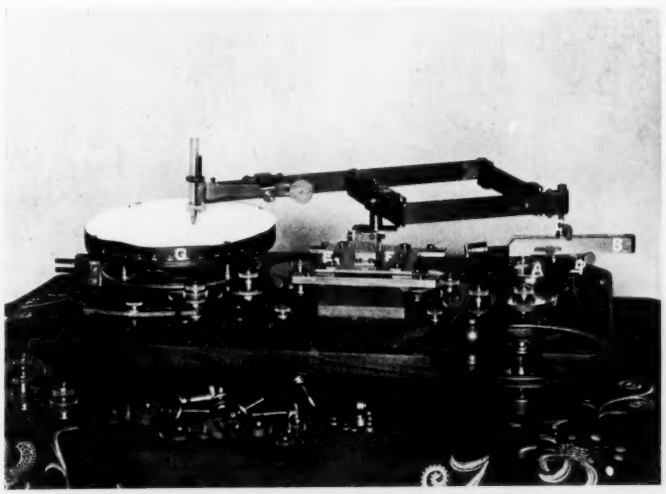

FIGURE 271. The Kaleidograph.

To the right of Figure 271 is seen an elliptic table (A). On the upper surface of this there are guides in which two runners slide along diameters at right angles to one another; the turned tops of these runners fit into the horizontal radial arm (B) above the table. Along the top of this arm another runner slides and may be clamped in any position; this carries the tracing point (C) of the pantograph.

The radial arm is rotated by an arm (D) fixed to a pulley beneath the elliptic table; the driving cord passes round this pulley. As this arm carries the radial arm round it will be seen that the tracing point describes an ellipse, the form of which is governed by the positions of the two runners in the ellipse table, and by the position at which the tracing point is clamped to the radial arm. By varying this position the ellipse may be thinned out into a straight line or by removing one of the runners and clamping the other in its guides, a circular movement of the tracing point is easily obtained.

The motions of the tracing point are transmitted unchanged to the pen over the drawing table, and as the radial arm revolves, an ellipse is drawn around which the pen will work as long as the arm is rotated.

By means of gearing, the elliptic table itself can be made to rotate in a direction the same or opposite to that of the radial arm. Thus the ellipse is made to rotate, and the number drawn in a complete rotation of the table depends on the gearing inserted between the two equal spur wheels beneath the table (A). The upper of these carries round with it the radial arm which in turn carries round the tracing point; the lower rotates the elliptic table.

In the centre of the machine are two sliding tables: the lower (E) slides towards and away from

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the drawing table while the upper (F) slides at right angles to it. Beneath these tables are two spur wheels identical with those beneath the elliptic table. The lower of these is free and is used when the

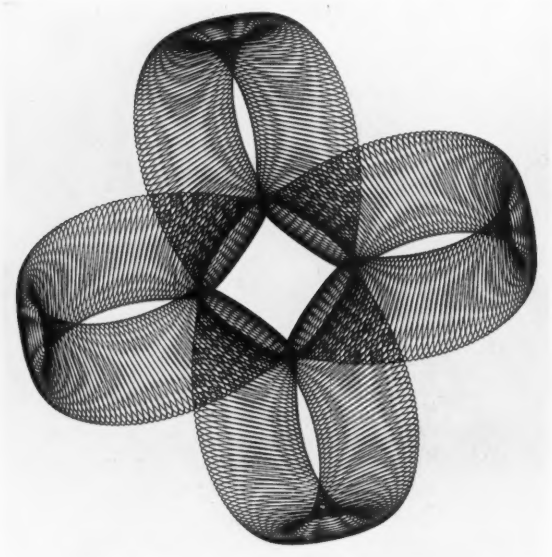


FIGURE 272.

motions of the tables are not required; the upper has a runner sliding in guides across its diameter. This may be clamped in any position and regulates the motion of the sliding tables—the more eccentric its position the more motion it imparts to the tables above. It is not always desirable to have both

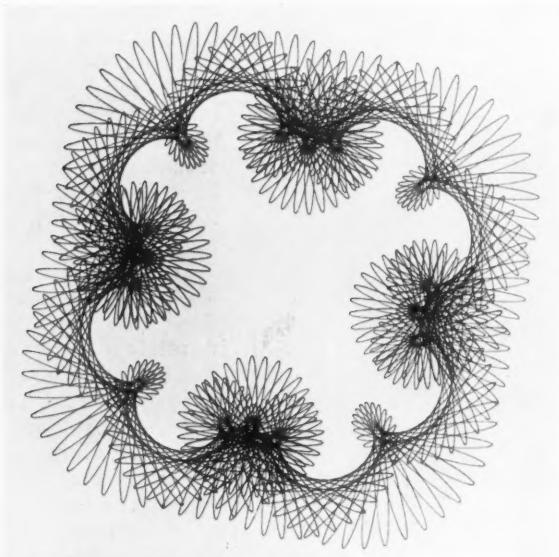


FIGURE 273.

sliding tables in use, as together they impart a circular motion to the central pivot (G) of the pantograph, whereas a simple harmonic motion is often required and is obtained by throwing the upper table out of gear, clamping it centrally and using only the lower table. Figure 275 was drawn with a circular motion of the central pivot

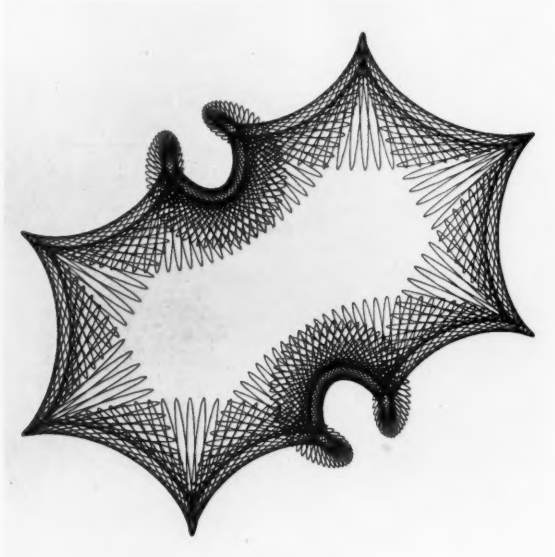


FIGURE 274.

while for Figure 276 only the lower table was used.

The central pivot of the pantograph is fixed above the tables and is carried along by them, all motion at this point being doubled at the drawing end of the pantograph.

The gearing inserted between the elliptic table

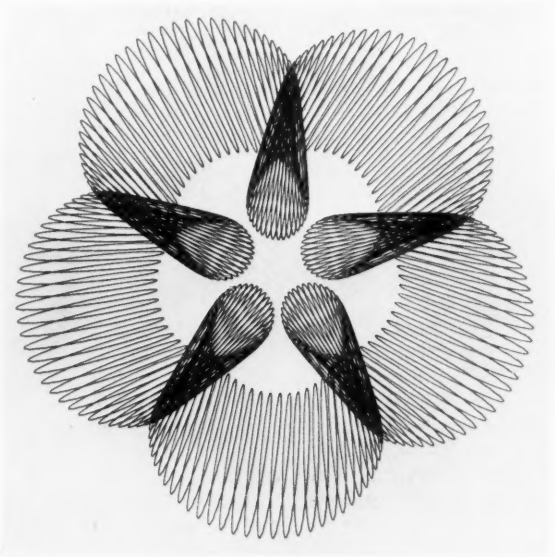


FIGURE 275.

and the central sliding tables has a great influence over the resulting design.

To the left of the machine is the drawing table (G),

which is mounted over a large spur wheel. Beneath this again is a smaller wheel which can, by means of an eccentric, cause the upper portion of the drawing table to move across the lower in a straight line backwards and forwards. The distance it travels is easily controlled by the eccentric, while the upper spur wheel is clamped when this motion is required.

Usually the drawing table revolves centrally, but by clamping the lower spur wheel and throwing the upper part of the drawing table eccentric an elliptical motion is obtained. (See Figure 274.)

The gearing between the central tables and the drawing table plays an important part in the form of the resulting design, as also does the direction in which the drawing table rotates. Figures 278 and 279 require almost the same setting, except that the drawing table revolves in opposite directions.

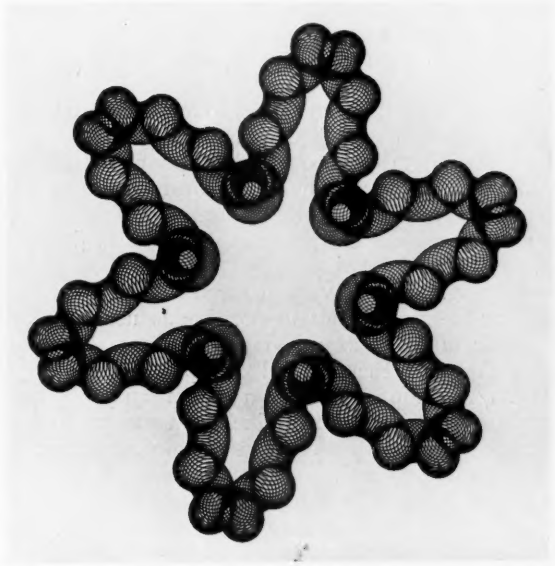


FIGURE 276.

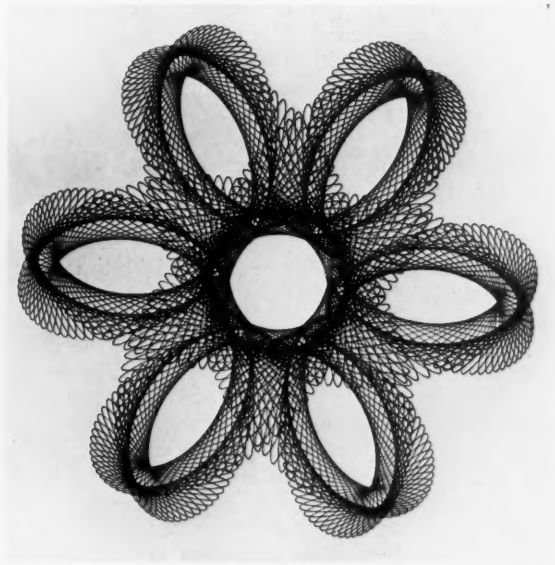


FIGURE 278.

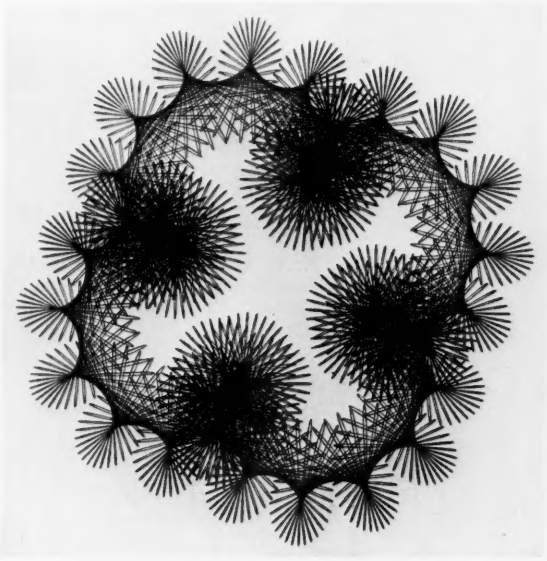


FIGURE 277.

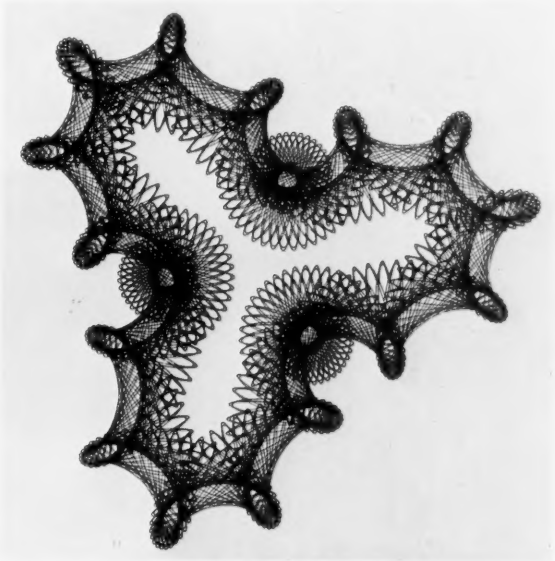


FIGURE 279.

This, of course, is not responsible for there being six arms in the former and only three in the latter.

When we consider the number of simple and complex motions which can be brought into action together or independently in varying ratios and opposite directions, it is not surprising that the resulting designs should be almost limitless in variety.

In order to make a little clearer what part each of

these movements plays in the design, it will be well to analyse the movements which have resulted in Figure 276.

In this case the tracing point (C) of the pantograph described a circle. This motion was obtained by removing one of the runners and clamping the remaining one round which the radial arm (B) rotated, carrying with it the tracing point. The position of the tracing point along the arm governed the diameter of the circle.

Between the upper and lower spur wheels beneath the elliptic table gears were introduced so that twenty-four circles were drawn to each complete rotation of the ellipse table. Gears were also introduced between this and the central sliding table so that the elliptic table revolved eight times while the central sliding table (E) moved once forward and backward. This, together with the fact that the runner was clamped a little eccentric on the elliptic table, is responsible for the eight nodes in each of the six arms, while there are twenty-four complete circles between any node and the next.

Only the lower of the two central sliding tables was used, and the distance it traversed was responsible for the length of the arms in the design.

The drawing table revolved centrally, one complete revolution coinciding with six double movements of the central sliding table. Thus the design has six arms.

For fine work, glass pens are used. A piece of glass tubing is drawn to a point and ground down until when the point is immersed in water and the other end blown down, a few bubbles are seen to slowly escape. The pen is filled with a solution of aniline dye.

The diagrams illustrating this article have, of necessity, to be coarse and give little idea of the delicacy that can be attained.

Very beautiful effects are produced by drawing such a design as Figure 275 in blue, turning the drawing table through 36° and repeating the same design in crimson. The form of the ellipse may also be slightly altered and the new design superimposed on the previous one, as was done in Figure 279.

An original and very convenient method for holding the gear wheels in position is used on this machine, and an examination of Figure 271 will perhaps make the method clear. The required wheels are slipped on to a drum and clamped together by a milled nut. The drum and wheels are then slipped together on to a spindle round which they can freely revolve. The spindle is clamped to the baseboard of the machine by means of another milled head, which springs a forked piece of lancewood, causing it to press the base of the spindle firmly down to the woodwork of the machine. They can thus be clamped in any position.

SOLAR DISTURBANCES DURING MAY, 1912.

By FRANK C. DENNETT.

DURING May the Sun's disc appeared free from disturbance on thirteen days—7th, 12th, 15th to 24th, and 30th, and on six others—5th, 9th to 11th, 25th and 26th,—only faculae were visible. The central meridian at noon on May 1st was 2° 1′.

The great faculic disturbance which originally appeared around the spot disturbance No. 1 in longitude 295° has continued visible, extending forward in longitude, and now reaching to 330°, but scarcely extends so far back as its place of origin. It is to be noted that the groups of spots Nos. 1, 3, 4 and 6 have all appeared within this area. Only one other faculic disturbance was recorded during the month, a small one near longitude 68° and in somewhat high South latitude, but its exact position was not measured.

No. 4 is an outbreak belonging to the April list, but shown on the present chart as it continued visible until May 6th.

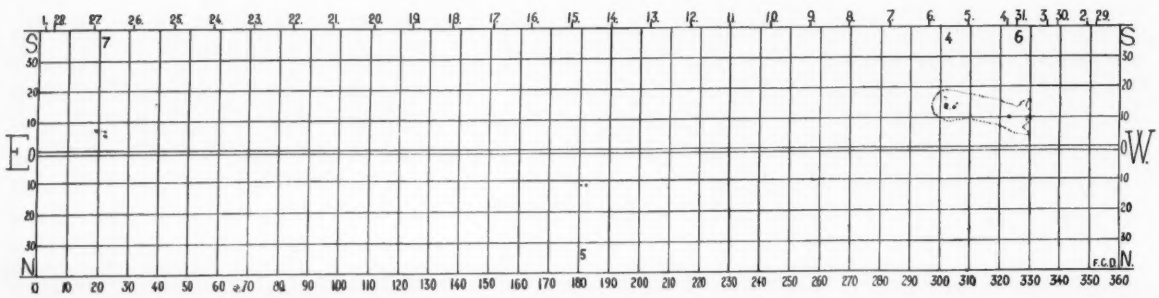
No. 5.—A black pore visible on the 13th and 14th only appearing smaller on the later date. On the afternoon of the 13th it was followed by a smaller grayish pore.

No. 6.—A group of very small pores, constantly changing in appearance, at the western end of the great faculic disturbance. Although never at one time more than 52,000 miles in length it seems to have been in reality 89,000 miles in extent, and was seen from the 27th until the 29th.

No. 7.—A group of three spotlets and a pore seen on the 31st, increasing during the day, the eastern and western spots each having about three umbrae. The length of the group increased to over 60,000 miles, and the diameter of the lower, eastern, spot was 11,000 miles. It was only seen until June the 2nd, after which it passed round the limb. With the spectroscope it was finely seen, a considerable dark hydrogen flocculus just west of one of the spots branching off the C line on the red side, whilst the D_3 line of helium was dark and thick on the 31st.

The chart is constructed from the combined observations of Messrs. J. McHarg, A.A.Buss, E. E. Peacock, and the writer, made in places so far separated as Lisburn, Manchester, Bath and Hackney.

DAY OF MAY, 1912.



SOME RARE SUSSEX ORCHIDS.

By E. J. BEDFORD.

DURING the past season (1911), I was able to add several interesting species to the collection I am forming of British Wild Orchids, and perhaps the following particulars may prove of interest.

My intention is to secure photographs of every possible species *in situ*, as well as at closer quarters at home, when arranged against a plain background. I was exceedingly fortunate in obtaining two species which had not hitherto been recorded for East Sussex, and these will be described first.

During the month of May, a friend of mine, Mr. Herbert Jenner, of Lewes, found in the Ouse district, near Lewes, a specimen of the Brown-veined Orchis (*Orchis purpurea*), and by his kindness I was able to obtain a photograph of the plant *in situ* and of the blossom (see Figure 283).

Although the specimen was not quite so fine as typical ones occurring in the neighbouring county of Kent, yet as a record for East Sussex it was of considerable local interest.

It will be remembered that we experienced some late frosts during the Spring of 1911, and this specimen like many of the earlier species suffered in consequence, the leaves being frost-bitten at the tips, and even as late as June I noticed that many specimens of the Bee Orchis (*Ophrys apifera*) suffered in the same way.

This interesting find was the prelude of another of perhaps even greater interest, for in the month of June I was fortunate enough to come upon a specimen of the Lizard Orchis (*Orchis hircina*) in the Cuckmere district, near Eastbourne.

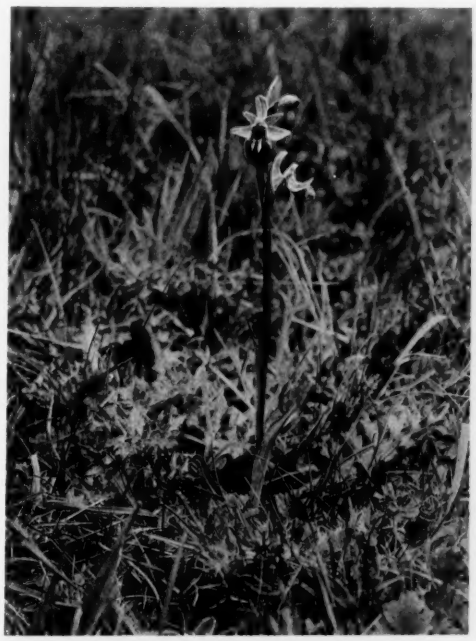


FIGURE 280.
The Spider Orchis (*Ophrys aranifera*) *in situ*.

FIGURE 281.
The Bog Orchis (*Malaxis paludosa*) in its natural habitat.

This also proved to be a record for East Sussex, although I believe a single specimen was discovered in West Sussex in 1907 near the extreme border of the county.

During the first week in June I had passed over the ground where the specimen was discovered and in the dusk of evening saw what appeared to be at a distance of several yards a plant of the Mullein (*Verbascum*).

It was, therefore, somewhat of a surprise to me in passing over the spot again about a week later (also in the twilight) to almost walk over a specimen of the Lizard Orchis which I had never dreamed I should be fortunate enough to find in Sussex. My thoughts at once went back to my previous visit to the locality, and I saw at once that this must have been what I had taken to be the Mullein.

My delight in the discovery may well be imagined by any botanist and I sat down beside the specimen debating in my mind whether I should pick it or leave it, as the flowers were not fully out—in fact, they had only just commenced to open. After considerable meditation I decided it must be picked as if it were left and someone else should discover it, which was more than likely owing to its position, the plant might be plucked up root and all before I had obtained a photograph and I should ever afterwards regret my loss. So I carefully cut off the blossom and packing it in my vasculum started homewards full of joy at my good fortune.

Several of my botanical friends were informed of

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my discovery and they also saw the blossom, but I have not, and do not intend to divulge the exact locality, hoping that the plant may blossom again during the coming season.

The plant measured twelve-and-a-half inches in height and doubtless would have grown higher had it been left to do so.

It is interesting to notice in the photograph of the partly-opened flowers (see Figure 284) how the long lip is curled up in the form of a spiral under the hood and one may be seen partly uncurled.

The flowers opened at the rate of three or four each day, and about a week after the specimen had been picked all the flowers were open except those at the extreme tip. It was at this stage taken back and temporarily fixed to its own stalk and photographed *in situ* on 22nd June (see Figure 282).

Earlier in the season I had found a very numerous colony of the Spider Orchis (*Ophrys aranifera*), which is one of the rarer species and very local in Sussex (see Figures 280 and 286).

Standing in one spot and revolving myself to face, in turn, the four points of the compass I counted the number of specimens I could clearly see in a circular space of about three yards radius from my standpoint and they numbered no less than sixty-five. They were in this profusion for a considerable distance on either side of me, and on making enquiries of my botanical friends I found only one of them had ever seen the species in such numbers.

FIGURE 282.
The Lizard Orchis (*Ophrys hircina*) *in situ*.

Fortunately this species, like several of the others belonging to the Orchidaceae, does not flower every successive season, so that where one season the flowers are very numerous (as they were on this occasion) the next very few may be found.

It is as well that this is so, otherwise local species like this would probably be exterminated by continual plucking of the flowers and perhaps grubbing up of the roots.

The specimens which occur in Sussex are said to be *Ophrys aranifera* var. *fucifera*. I have experienced great difficulty, however, in distinguishing the variety from the type which is said to occur in Kent and sometimes in Sussex.

The species known as the Late Spider Orchis (*Ophrys arachnites*), which occurs in Kent, and, I believe, also in Surrey, is a very rare plant. I have heard that it has been found in Sussex, but have never seen it there myself.

As it occurs about a month later than *O. aranifera* there seems little doubt but that it is a distinct species, more related to *O. apifera* than *O. aranifera*.

Another interesting species to be found in Sussex is the Bog Orchis (*Malaxis paludosa*), which is very local and not at all common. This, as its name implies, is to be found in bogs and owing partly to its position, and also on account of its small size, is not at all easy to discover or, when discovered, to photograph.

It is said to be an epiphyte —that is, a plant which grows upon another plant, but which does not, like a parasite, obtain its nourishment from it. It is often, but not always, found upon Bog Moss (*Sphagnum*). The specimen shown in the illustration (see Figure (281) was growing upon *Sphagnum*, and was only one and a half inches in height, doubtless due to the very dry summer; which had the advantage, however, of making its habitat more easily accessible. Owing to the damp situation and the very small size of the specimen, it took a considerable amount of manoeuvring before the camera, which had to be placed almost upon the ground, could be brought into a favourable position to secure the photograph. Specimens seemed very scarce in Sussex during 1911, but this may have been due to the abnormally hot and dry season.

Darwin mentions in his book on "Fertilisation of Orchids"* that the specimens he experimented with were sent to him from Sussex, and it is interesting to note that there is very little doubt they came from the same locality as the one shown in the illustration.

This species is the smallest British Orchid, and its labellum or lip is, contrary to most others, directed upwards, this being brought about by the spiral twisting of the ovarium.

The proper direction for the lip of all Orchids is upwards, but the lower position is assumed by reason of the twisting of the ovarium. In *Malaxis* the twist continues until the lip is again brought round to the upward position.

This is well shown in the illustration of the species in Darwin's work already mentioned.

* Pages 129 and 130.

FIGURE 283. The Brown-Veined Orchis (*Orchis purpurea*).

FIGURE 284. The Lizard Orchis (*Orchis hircina*).

FIGURE 285. The Lizard Orchis (*Orchis hircina*).

FIGURE 286. The Spider Orchis (*Ophrys aranifera*).

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THE TRANSMUTATION OF THE ELEMENTS.

By H. STANLEY REDGROVE, B.Sc. (Lond.), F.C.S.

1.—The Theories of the Alchemists.

The alchemists have, in the past, been too harshly judged. Their views were certainly fantastic in form, their method of gaining truth unreliable; but they were not fools who hid their folly under an unintelligible phraseology, nor were they mere seekers after material wealth. We are, of course, referring to the genuine alchemists, not to the horde of swindlers, who in Alchemy's later days adopted the alchemistic guise for sinister purposes. The alchemists were philosophers who held a certain view as to the nature of the Cosmos, which they attempted to demonstrate by experiments on metals and allied substances.* The final proof of their theory, they believed, would be found in the transmutation of the "base" metals into gold; and it was as the final proof of their theory that they so ardently toiled to achieve this transmutation. As one of them exclaims, "Would to God . . . all men might become adepts in our art—for then gold, the great idol of mankind, would lose its value, and we should prize it only for its scientific teaching."

Figure 287.

Portrait of Theophrast Bombast von Hohenheim, called Paracelsus (1493–1541), from an engraving by Gaywood after Rubens.

There was a maxim beloved by all the alchemists, which briefly formulates the basic principle of their system. It runs—"What is below is as that which is above, what is above is as that which is below." The alchemistic theory of the Cosmos was mystical, it asserted the unity of all things and relied chiefly on analogy as its organon of thought. In particular, the alchemists believed that there was an analogical relation between the metals and man as a spiritual being. They attempted to transfuse mystical theological doctrines concerning man and his destiny into physics, explaining the properties and behaviour of metals and other substances by means of such doctrines physically interpreted.

Their elements (earth, water, air and fire) were not different sorts of matter, but different properties manifested by the one matter. Mystical theology asserts that man is triune, consisting of body, soul (=will and affections) and spirit (=intelligence). The alchemists were, therefore, led to the idea that there are three principles in the metals, generated by the four elements, namely salt (principle of stability and resistance), sulphur (principle of combustion and colour), and mercury (the essentially metallic principle). Moreover, still following mystical theology and arguing by analogy, they asserted that, whilst there is only one mercury, there are two sulphurs, one inward and pure, the other outward and gross; and that gold, the most perfect metal, is produced when pure mercury is matured by the action of pure, inward sulphur. Of course, this notion of three principles underlying all things, like the other alchemistic hypotheses, was not formulated at once, but was the result of many generations of speculative thought. This particular notion became very generally believed in after Paracelsus's vigorous championship of it. (See Figure 287.)

In gold, the beautiful metal which entirely resisted the powers of their furnaces permanently to alter its nature, they saw a symbol of perfected humanity, whilst lead, the unlovely metal so readily converted into a "calx" by fire, they regarded as an analogue of unregenerate man. They believed, in accordance with their fundamental principle, that all the metals are produced from one seed in Nature's womb by

* For a fuller discussion of Alchemy and the alchemists, with particular reference to the relation between Alchemy and Modern Science, see the present writer's "Alchemy: Ancient and Modern" (Rider, 1911).

an evolutionary process which works upwards from lead to gold. They believed, further, that man, given the right methods, might assist in this process, producing the final result more speedily. This, the transmutation of the "base" metals into gold, was to be accomplished, they believed, by means of that One Thing which is the origin of, and lies concealed within, all things—not, however, in its pure, transcendent state, but concentrated in a suitable material form. This was the Philosopher's Stone. To achieve the *magnum opus*, as this transmutation was called, was to have gained the One Thing, and to have demonstrated the validity of the alchemistic theory.

In the alchemistic theory of the transmutation of the metals by the aid of that wonderful arcanum, the Philosopher's Stone, we have an attempted physical application of mystical theological doctrines concerning man's regeneration. It is impossible to suppose that so curious a theory as this could have been suggested to the alchemists merely by the results of their chemical experiments. Once formulated, however, many facts (*e.g.*, the apparent transmutation of iron into copper when immersed in a solution of blue vitriol) were noted that could be instanced in support of this and their other curious theories.

FIGURE 288.

Portraits of J. B. van Helmont (1577–1644) and his son, F. M. van Helmont (1618–1699), from the Frontispiece to J. B. van Helmont's "Oriatrike."

Many cases of the supposed transmutation of "base" metals into gold are recorded by the alchemists. Perhaps the most interesting claim to have affected the *magnum opus* is that of John Baptist van Helmont (see Figure 288), a celebrated seventeenth-century chemist and physician, who invented the word *gas*, and was the first chemist to investigate the gas now known as carbon dioxide. He says that he converted quicksilver (eight ounces on one occasion, nine ounces and three-quarters on another) into gold, by the aid of small quantities of a yellow, dense, crystalline powder of unknown composition, which had been given to him by a stranger.* Undoubtedly, however, the alchemists were frequently deceived by yellow alloys superficially resembling gold; which may have been the case with van Helmont—lacking definite evidence, definite statements are unwise.

Modern science, which works from facts to theories, not from theories to facts, stands in strong contrast with the science of the ancients. Indeed, the contrast is so great that nowadays many of the theories of the alchemists seem almost unintelligible; and confusion is rendered the worse by their use of diverse and often conflicting symbols and systems of nomenclature. But despite the fantastic mould in which their ideas were cast, as we have indicated already, the alchemists do appear to have intuitively grasped certain fundamental facts, which lost awhile, are being rediscovered by the more certain, if less rapid, methods of modern science. The investigations of radioactivity and allied phenomena have demonstrated that the so-called elements are not immutable, but are one in essence and are produced by an evolutionary process; so the alchemists, in a sense, were right, and the followers of Dalton wrong. As Sir William Tilden remarks: ". . . It appears that modern ideas as to the genesis of the elements, and hence of all matter, stand in strong contrast with those which chiefly prevailed among experimental philosophers from the time of Newton, and seem to reflect in an altered form the speculative views of the ancients."† Moreover, recent researches by Sir William Ramsay indicate the possibility of producing true transmutations of the elements, meaning thereby the conversion of one element into another at will, as distinguished from a spontaneous change of one element into another. We shall now briefly discuss these researches.

* See J. B. van Helmont: "Oriatrike" (trans. by J. C., 1662), pages 751, 752, and 807.

† Sir William A. Tilden: "The Elements: Speculations as to their Nature and Origin" (1910), pages 108, 109.

2.—THE RESEARCHES OF SIR WILLIAM RAMSAY.

It is now generally known that Radium (which chemically speaking must be reckoned as an element) spontaneously disintegrates into two other elements, Niton (the radium-emanation, a heavy, chemically-inactive gas) and Helium. Niton behaves in a similar manner, yielding Helium and a solid substance, Radium A, which in its turn also disintegrates. In fact, it appears that there are no "elements" which are perfectly stable, though it is only in these and certain other cases that the amount of disintegration is sufficient to make itself appreciably felt. All such sub-atomic changes, as these may be termed, are accompanied by relatively large energy changes. This is particularly the case with respect to the disintegration of Niton. It has been estimated that the decomposition of one cubic centimetre of Niton is accompanied by the evolution of about four million times as much heat as is obtained by the combustion of an equal volume of hydrogen. It is evident, therefore, that locked up within the chemical atoms there must be a store of potential energy so vast that the human mind can scarce conceive of it. It is a fair inference to suppose that in order to bring about the conversion of one element into another at will, energy at an excessively high potential, in a highly concentrated form, so to speak, such as is obtainable from no ordinary sources, is necessary. In fact, the only energy of this sort available is that given out with the spontaneous decomposition of Niton and other highly radio-active elements. Even then, as the actual quantity of energy given out during ordinary periods of time is comparatively small, owing to the fact that such sub-atomic changes are comparatively slow, it appears that, granting the transmutation of the elements to be possible by this means, only microscopical quantities could be actually transmuted. The only case in which one can suppose transmutation of large quantities of an element as possible, would be in the event of there existing a substance which would catalytically convert one element into another containing less potential energy. There is no inherent impossibility in this latter supposition; but, on the other hand, no such catalyst is known. That the energy obtained by the spontaneous decomposition of Niton, however, may be utilised for transmuting microscopical quantities of various elements is indicated by the researches of Sir William Ramsay.

His first experiments were carried out on distilled water, and the result confirmed later by a more accurate experiment carried out in conjunction with Mr. Cameron.* In this experiment the water, upon which a small quantity of Niton was allowed to act, was contained in a silica-bulb. The gases produced were removed: these consisted mainly of oxygen and hydrogen, due to the chemical decomposition of the water. The residual gas, after removing the ordinary gases, was examined spectroscopically. Helium was present, owing to the disintegration of the Niton in the gas-phase in the bulb; but besides the Helium lines, the characteristic lines of Neon were also observed. This is shown in Figure 289, which is here reproduced from *The Journal of the Chemical Society* by kind permission of Sir William Ramsay, to whom the present writer's thanks are due. A is the spectrum of pure Helium; B, that of the iron arc; C and D are different photographs of the gases under examination†; whilst E is the spectrum of pure Neon. Ramsay and Cameron conclude their paper as follows: "We must regard the transformation of emanation into Neon, in presence of water, as indisputably proved, and, if a transmutation be defined as a transformation brought about at will, by change of conditions, then *this is the first case of transmutation of which conclusive evidence is put forward.*"

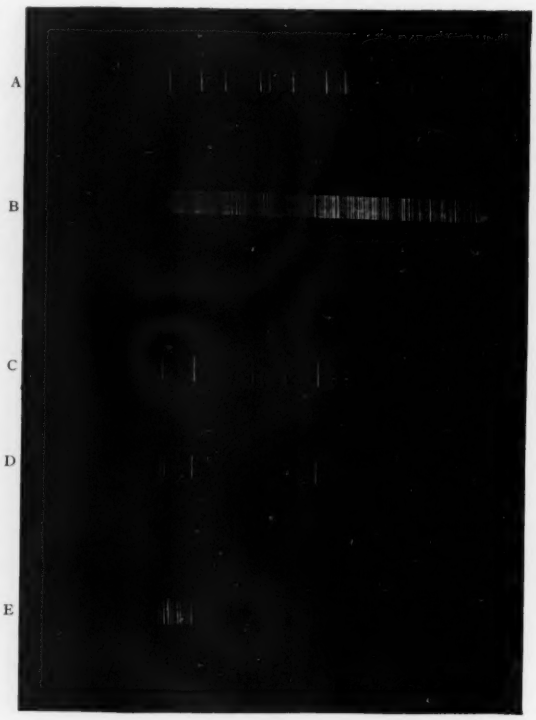

FIGURE 289.

Photographs of Spectra (Ramsay).

A, Pure Helium; B, Iron-Arc; C, Gases under examination (2nd photograph); D, Gases under examination (1st photograph); E, Pure Neon.

The same chemists also carried out similar experiments, in which a salt of copper was added to the

* *Journal of the Chemical Society*, Vol. XCI (1907), pages 931 *et seq.*, Vol. XCIII (1908), pages 966 *et seq.*

† Regarding these photographs the authors write, "The reproduction only shows some of the strongest red lines of neon in C and D. The helium and neon yellow lines appear as one thick line in the reproduction, although on the plate they are seen to be distinct." The photograph C was taken after D, when many of the neon lines had faded.

water.* After removing the copper, spectroscopic analysis revealed the presence of a considerable quantity of Sodium, together with traces of Lithium. In the case of copper nitrate the gas obtained showed the presence of Argon, but no Helium.

Another series of experiments have been carried out by Sir William Ramsay alone and in conjunction with Mr. F. L. Usher on the action of Niton on solutions of compounds (not containing carbon) of Silicon, Titanium, Zirconium, Thorium and Lead.† In every case, save that of lead, carbon dioxide was produced. Sir William Ramsay also obtained carbon dioxide by the action of Niton on a solution of bismuth perchlorate.

In all these cases it will be noted that the element obtained is of a lighter atomic weight than that which is disintegrated, and that, save in the case of the transmutation of bismuth into carbon, the element produced is always one occurring in the same column of the Periodic Table as that from which it is obtained. Thus Helium (3·99), Neon (20·2), Argon (39·88), and Niton (222·4) occur together in column 0; Lithium (6·94), Sodium (23·00), and Copper (63·57) in column 1; and Silicon (28·3), Titanium (48·1), Zirconium (90·6), and Thorium (232·0) in column 4. No case has yet been observed in which an element appears to be transmuted into one of higher atomic weight; though there is no inherent reason, if we can "degrade" elements, why we should not be able to build them up.

Professor Rutherford and Mr. Royds, who have also examined the action of Niton on water, question the validity of Sir William Ramsay's conclusions, and suggest that the presence of Neon in his experiments was due to leakage of air into the apparatus.‡ But in a further experiment by Ramsay, described at a recent meeting of the Chemical Society, the quantity of Neon obtained, compared with that of Argon, was far in excess of what would have been present had it been due only to leakage. No one can read the accounts of Sir William Ramsay's experiments without being impressed by the careful attention bestowed to those small details whose neglect spells error. The first step only has been made into a new realm of science, and no doubt conclusions will have to be modified as progress is made. But, taken as a whole, these experiments do indicate that the transmutation of the elements is not merely an idle dream, as was at one time supposed.

* *Journal of the Chemical Society*, Vol. XCI (1907), pages 1593 *et seq.* The transmutation of copper into lithium is disputed by Madame Curie and Mademoiselle Gleditsch.

† *Journal of the Chemical Society* (1909), Vol. XCV, pages 624 *et seq.*; and *Chemical News* (1909), Vol. C, page 209.

‡ *Philosophical Magazine* (1908) [6], Vol. XVI., pages 812 *et seq.*

A NEW SIDEREAL WATCH.

A CORRESPONDENT writes:—It may interest your readers to know that the Waltham Watch Company have lately placed on the market an excellent sidereal watch. (See Figure 290.) The movement is in every way first class and fully jewelled, and when tested by transit observations the rate is exceedingly close. The seconds dial is large and plain so that, using Herschel's method of counting, time may be easily taken to about a fifth of a second for each wire. A professional astronomer would find it just the thing for a deck watch to carry about with him, whilst it would serve every purpose of the amateur and obviate the necessity for a sidereal clock. It has, of course, a compensation balance, and is corrected for temperature and for all five positions. It is in a dust-proof screw case and costs £10.

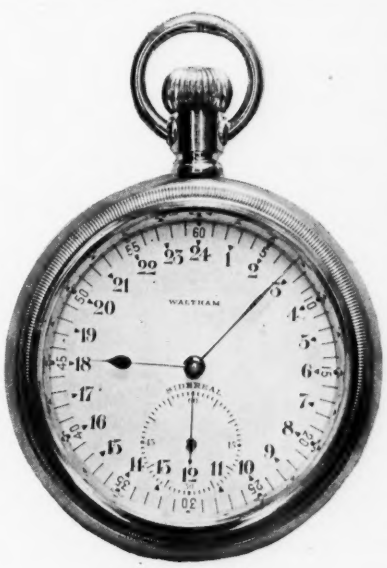

FIGURE 290.

The same Company are also making an eight-day lever chronometer (see Figure 291) mounted in a box with gimbals. It has only been out a few months or so. It is sent out duly rated to mean time, and costs £12.

FIGURE 291.

THE FACE OF THE SKY FOR AUGUST.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

Date.	Sun. R.A.	Sun. Dec.	Moon. R.A.	Moon. Dec.	Mercury. R.A.	Mercury. Dec.	Venus. R.A.	Venus. Dec.	Jupiter. R.A.	Jupiter. Dec.	Saturn. R.A.	Saturn. Dec.	Uranus. R.A.	Uranus. Dec.
Greenwich Noon.	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°
Aug. 3	8 52·8	N. 17·5	0 35·0	N. 3·3	10 25·1	N. 6·8	9 25·9	N. 16·6	16 15·0	S. 20·7	4 3·1	N. 18·7	20 13·9	S. 20·5
,, 8	9 12·0	16·2	4 52·7	N. 27·0	10 27·6	5·5	9 50·2	14·6	16 15·2	20·7	4 4·6	13·8	20 13·0	20·6
,, 13	9 31·0	14·7	10 12·9	N. 14·8	10 22·5	5·3	10 14·1	12·5	16 15·7	20·7	4 5·9	18·8	20 12·3	20·6
,, 18	9 49·7	13·1	14 30·4	S. 17·3	10 10·2	6·3	10 37·5	10·2	16 16·6	20·8	4 7·0	18·8	20 11·5	20·6
,, 23	10 8·2	11·5	18 57·0	S. 28·0	9 54·6	8·2	11 0·6	7·9	16 17·7	20·8	4 8·0	18·9	20 10·8	20·7
,, 28	10 26·5	N. 9·8	22 58·3	S. 9·4	9 43·1	N. 10·6	11 23·4	N. 5·4	16 19·2	S. 20·9	4 8·8	N. 18·9	20 10·1	S. 20·7

TABLE 26.

Date.	Sun. P	Sun. B	Sun. L	Moon. P	Jupiter. P	Jupiter. B	Jupiter. L_1	Jupiter. L_2	Jupiter. T_1	Jupiter. T_2	Saturn. P	Saturn. B
Greenwich Noon.	°	°	°	°	°	°	°	°	h m	h m	°	°
Aug. 3	+11·8	+6·0	198·3	−21·6	+10·2	−2·7	140·9	0·4	6 0 *e*	9 56 *e*	−3·0	−25·0
,, 8	13·7	6·3	132·1	−5·8	10·2	2·7	210·0	21·3	6 16 *m*	11 9 *m*	3·1	25·1
,, 13	15·5	6·6	66·0	+19·6	10·1	2·7	279·0	62·2	2 14 *e*	0 22 *m*	3·1	25·1
,, 18	17·2	6·8	0·0	+16·9	10·0	2·7	347·9	92·9	0 21 *e*	7 23 *e*	3·1	25·1
,, 23	18·7	7·0	293·9	−5·7	9·9	2·7	56·8	123·6	0 37 *m*	8 36 *m*	3·2	25·1
,, 28	+20·2	+7·1	227·8	−21·2	9·8	−2·6	125·5	154·3	6 26 *e*	5 41 *e*	−3·2	−25·1

TABLE 27.

P is the position angle of the North end of the body's axis measured eastward from the North Point of the disc. B, L are the helio-(planeto-)graphical latitude and longitude of the centre of the disc. In the case of Jupiter L_1 refers to the equatorial zone, L_2 to the temperate zones. T_1 T_2 are the times of passage of the two zero meridians across the centre of the disc; to find intermediate passages apply multiples of $9^h\ 50\frac{1}{2}^m$, $9^h\ 55\frac{1}{2}^m$ respectively.

The letters *m*, *e* stand for morning, evening. The day is taken as beginning at midnight.

THE SUN moves South pretty rapidly. Sunrise during August changes from 4–26 to 5–13; sunset from 7–46 to 6–47. Its semi-diameter increases from 15′ 47″ to 15′ 53″.

MERCURY is an evening Star till the 22nd, when it passes Inferior Conjunction and becomes a morning star. On August 1st, one-third of disc is illuminated, semi-diameter $4\frac{1}{2}''$; on August 31st, one-sixth of disc is illuminated, semi-diameter $4\frac{1}{2}''$.

VENUS is an evening Star, but too near the Sun for convenient observation. Illumination nearly complete, semi-diameter 5″.

THE MOON.—Last Quarter $6^d\ 4^h\ 18^m m$; New $12^d\ 7^h\ 58^m e$; First Quarter $19^d\ 4^h\ 57^m e$; Full $27^d\ 7^h\ 59^m e$. Perigee $12^d\ 10^h m$, semi-diameter 16′ 44″; (only 3″ less than the very high value last January); Apogee $25^d\ 9^h m$, semi-diameter 14′ 44″. Maximum Librations, August 6^d, 8° E., 10^d 7° S., 18^d 8° W., 23^d 7° N. The letters indicate the region of the Moon's limb brought into view by libration. E. W. are with reference to our sky, not as they would appear to an observer on the Moon.

MARS is an evening Star, but practically invisible.

JUPITER is an evening Star, increasing its distance from us, so that the equatorial semi-diameter diminishes from $20\frac{1}{2}''$ to $18\frac{1}{2}''$. The Polar is smaller by $1\frac{1}{3}''$. The configurations of the satellites at 9^h *e* are for an inverting telescope (see Table 29).

Satellite phenomena visible at Greenwich, $3^d\ 9^h\ 50^m$ III. Tr. E., $9^h\ 58^m$ II. Tr. I., $11^h\ 25^m$ I. Oc. D.; $4^d\ 8^h\ 39^m$ I. Tr. I., $9^h\ 50^m$ I. Sh. I., $10^h\ 53^m$ I. Tr. E.; $5^d\ 9^h\ 15^m\ 57^s$ I. Ec. R., $9^h\ 37^m\ 25^s$ II. Ec. R.; $11^d\ 10^h\ 31^m$ I. Tr. I.; $12^d\ 7^h\ 44^m$ I. Oc. D.; $13^d\ 8^h\ 29^m$ I. Sh. E.; $14^d\ 8^h\ 43^m\ 34^s$ III. Ec. R.; $19^d\ 9^h\ 37^m$ I. Oc. D., $9^h\ 37^m$ II. Oc. D.; $20^d\ 8^h\ 10^m$ I. Sh. I., $9^h\ 7^m$ I. Tr. E., $10^h\ 24^m$ I. Sh. E.; $21^d\ 7^h\ 34^m\ 15^s$ I. Ec. R., $7^h\ 35^m$ III. Oc. R., $9^h\ 26^m$ II. Sh. E.; $27^d\ 8^h\ 47^m$ I. Tr. I., $10^h\ 5^m$ I. Sh. I.; $28^d\ 9^h\ 13^m$ III. Oc. D., $9^h\ 20^m$ II. Sh. I., $9^h\ 28^m$ II. Tr. E., $9^h\ 29^m\ 7^s$ I. Ec. R.; $30^d\ 6^h\ 49^m\ 42^s$ II. Ec. R.

All the above are in the evening hours.

The eclipse reappearances of I. II. and both phases of those of III. occur high right of the inverted image, taking the direction of the belts as horizontal.

Date.	Star's Name.	Magnitudes.	Disappearance. Mean Time.	Disappearance. Angle from N. to E.	Reappearance. Mean Time.	Reappearance. Angle from N. to E.
1912.			h. m.		h. m.	
Aug. 6 ...	36 Arietis	6·5	2 35 *m*	59°	3 45 *m*	238°
,, 16 ...	BAC 4394	5·6	7 26 *e*	170	8 5 *e*	247
,, 22 ...	Lacaille 7730	7·0	8 47 *e*	88		
,, 22 ...	Lacaille 7759	7·0	10 36 *e*	90		
,, 23 ...	BAC 6628	5·9	9 59 *e*	25	10 52 *e*	305
,, 29 ...	BD—7° 6012	7·0			2 0 *m*	233
,, 31 ...	BAC 274	6·3	6 9 *m*	332	6 12 *m*	326

TABLE 28. Occultations of stars by the Moon visible at Greenwich.

From New to Full disappearances occur at the Dark Limb, from Full to New reappearances.

XUM

SATURN is a morning Star. Polar semi-diameter $8\frac{1}{3}''$. The major axis of the ring is $41\frac{3}{4}''$, the minor axis $17\frac{3}{4}''$. The ring is now approaching its maximum opening, and projects beyond the poles of the planet.

East elongations of Tethys (every fourth given). August $3^d\ 4^h{\cdot}2\ m$, $10^d\ 5^h{\cdot}5\ e$, $18^d\ 6^h{\cdot}8\ m$, $25^d\ 8^h{\cdot}0\ e$, September $2^d\ 9^h{\cdot}3\ m$. Dione (every third given). August $3^d\ 5^h{\cdot}9\ m$, $11^d\ 11^h{\cdot}1\ m$, $19^d\ 4^h{\cdot}2\ e$, $27^d\ 9^h{\cdot}3\ e$.

Rhea (every second given). August $4^d\ 11^h{\cdot}4\ e$, $14^d\ 0^h{\cdot}5\ m$, $23^d\ 1^h{\cdot}3\ m$, September $1^d\ 2^h{\cdot}3\ m$.

For Titan and Iapetus, E., W. means East and West elongations, I., S. Inferior and Superior Conjunction, Inferior being to the North, superior to the South. Titan, $4^d\ 7^h{\cdot}8\ m$ S., $8^d\ 11^h{\cdot}5$ E., $12^d\ 0^h{\cdot}7\ e$ I., $16^d\ 8^h{\cdot}9\ m$ W., $20^d\ 7^h{\cdot}6\ m$ S., $24^d\ 11^h{\cdot}2\ m$ E., $28^d\ 0^h{\cdot}2\ e$ I., September $1^d\ 8^h{\cdot}2\ m$ W. Iapetus $5^d\ 4^h{\cdot}8\ m$ S., $25^d\ 6^h{\cdot}7\ e$ E.

URANUS is an evening Star, semi-diameter 2″. It is $7\frac{1}{2}°$ South of Alpha Capricorni, 5° South West of Beta.

NEPTUNE is invisible.

METEOR SHOWERS (from Mr. Denning's List):—

Date.	Radiant. R.A.	Radiant. Dec.	Remarks.
May 30 to Aug.	333°	+ 28°	Swift, streaks.
June to Aug.	310	+ 61	Swift, streaks.
June to Sept.	335	+ 57	Swift.
June to Aug.	303	+ 24	Swift.
July to Aug.	308	− 12	Slow, long.
July 25 to Sept. 15	48	+ 43	Swift, streaks.
July to Sept.	335	+ 73	Swift, short.
July to Aug.	280	+ 57	Slow, short.
July to Oct...	355	+ 72	Swift, short.
Aug. 10—13	45	+ 57	Perseids. Swift, streaks.
Aug., Sept. ..	353	− 11	Rather slow.
Aug. 15 ...	290	+ 53	Swift, bright.
,, 15—25 ...	291	+ 60	Slow, bright.
,, 25 ...	5	+ 11	Slow, short.
Aug., Sept....	346	0	Slow.
Aug. to Oct. 2	74	+ 42	Swift, streaks.
Aug., Sept ..	63	+ 22	Swift, streaks.

Day.	West	East	Day.	West	East
Aug. 1	12	○ 34	Aug. 17	1	○ $^{2}_{3}$ 4
,, 2		○ $1^{2}_{4}3$	,, 18	$^{3}_{3}$	○ 14
,, 3	1	⊙ $^{2}_{4}$	,, 19	3^{2}_{1}	○ 4
,, 4	3^{2}_{4}	⊙	,, 20	34	⊙ 2
,, 5	43	○ 2● 1●	,, 21	42	○ 31
,, 6	431	○ 2	,, 22	421	○ 3
,, 7	42	○ $^{3}_{1}$	,, 23	4	○ $^{2}_{4}$ 3
,, 8	4^{2}_{1}	○ 3	,, 24	41	○ $^{2}_{3}$
,, 9	4	○ 123	,, 25	4^{2}_{3}	○ 1
,, 10	41	○ $^{2}_{3}$	,, 26	43^{2}_{1}	○
,, 11	324	○ 1	,, 27	34	⊙ 2
,, 12	3	○ 4 2● 1●	,, 28	$^{1}_{3}$	⊙ 1●
,, 13	31	○ 24	,, 29	21	○ 43
,, 14	2	○ $^{3}_{1}$ 4	,, 30		○ $^{2}_{1}$ 34
,, 15	21	○ 34	,, 31	1	○ $^{0}_{3}$ 4
,, 16		○ 1234			

TABLE 29.

CLUSTERS AND NEBULAE.

Name.	R.A.	Dec.	Remarks
M. 56	19h 13m	N 29°·1	Globular cluster.
♃ IV 51	19 38	S 14 ·3	Planetary nebula.
M. 71	19 49	N 18 ·6	Faint cluster. 1° S.W. of γ Sagittae.
M. 27	19 55	N 22 ·5	The Dumb Bell nebula in Vulpecula.
M. 75	20 0	S 22 ·2	
♃ VII. 59	20 1	N 43 ·8	Cluster.
♃ VIII. 56	20 20	N 40 4	Cluster. $\frac{1}{2}$° N. E. of γ Cygni.
♃ I. 103	20 29	N 7 ·1	
♃ IV. 1	20 59	S 11 ·7	Remarkable planetary nebula.

DOUBLE STARS.—The limits of R.A. are 19^h to 21^h.

Star.	Right Ascension. h. m.	Declination.	Magnitudes.	Angle. N. to E.	Distance.	Colours, etc.
17 Lyrae	19 4	N 32°·4	$5\frac{1}{2}$, $9\frac{1}{2}$	310°	3″	Yellow, blue.
Groombridge 2789 ...	19 10	N 49 ·7	6, 6	217	9	Yellow.
η Lyrae	19 11	N 39 ·0	4, 8	83	28	Blue, ash.
23 Aquilae	19 14	N 0 ·9	$5\frac{1}{2}$, $9\frac{1}{2}$	8	3	Yellow, blue.
δ Cygni	19 42	N 44 9	3, 8	290	$1\frac{1}{2}$	White, blue.
ζ Sagittae	19 45	N 19 ·0	6, 9	310	9	White, blue.
	The principal star is a very close double, $\frac{1}{4}''$ apart.					
ε Draconis	19 49	N 70 ·1	4, $7\frac{1}{2}$	10	3	Yellow, blue.
ψ Cygni	19 54	N 52 ·2	5, $7\frac{1}{2}$	181	3	White, ash.
θ Sagittae	20 6	N 20 ·7	6, 8	327	11	Yellow, ash.
	There is a 7th mag. star 1′ away.					
Groombridge 3142 ...	20 16	N 55·2	6, 7	337	3	White, ash.
κ Cephei	20 13	N 77 ·5	4, 8	123	7	Green, blue.
γ Delphini	20 43	N 15 ·9	4, 5	269	11	Orange, green.
4 Aquarii	20 47	S 5 ·9	6, 7	310	$\frac{1}{3}$	Yellow.
	Period 136 years.					
ε Equulei	20 55	N 4 ·0	$5\frac{1}{2}$, 6	286	$\frac{1}{2}$	Yellow.
	Also a 7th mag. at 73° 10″.					
Piazzi xx, 429	20 59	N 50 ·2	6, $7\frac{1}{2}$	32	2	White.
12 Aquarii	20 59	S 6 ·1	$5\frac{1}{2}$, $7\frac{1}{2}$	190	$2\frac{1}{2}$	Yellow, blue.

TABLE 30.

XUM

REVIEWS.

BACTERIOLOGY.

Microbes and Toxins.—By DR. ETIENNE BURNET (of the Pasteur Institute, of Paris), with a preface by ÉLIE METCHNIKOFF. Translated from the French by DRS. C. BROQUET and W. M. SCOTT. xvi + 316 pages. 7½-in. × 5-in.

(W. Heinemann. Price, 5/- net.)

The writing of a booklet on some technical subject which shall be interesting and intelligible to the educated public and also correct and which shall at the same time assume no previous knowledge of this or kindred subjects, is a much more difficult task than might at first sight appear, and few who have the requisite knowledge have the necessary patience to carry it through.

The writer of the book before us is eminently qualified for the work he has undertaken, and has succeeded in making every page of it both interesting and easily intelligible. A short summary of its contents precedes each chapter so that it is easy to find any details for which we are seeking. Inflammation, immunity, antitoxins and vaccines and a host of similar subjects are, of course, dealt with. But besides these, reference is made to subjects of more general interest. The bacteria of coal, the root nodules by which certain plants are able to abstract the nitrogen from the air, and the lactic bacteria which ferment milk are all described. It may be news to some of us that our large intestine is "not only a useless but an injurious organ," but the author assures us that this is so and maintains his point well. By far the best general account of the microbes of health and disease that we have yet seen, is contained in the volume before us.

S. H.

BIOLOGY.

The Origin of Life: being an account of experiments with certain superheated saline solutions in hermetically sealed vessels.—By H. CHARLTON BASTIAN, M.D., F.R.S. 76 pages. 10 plates. 10-in. × 6¼-in.

(Watts & Co. Price 3/6 net.)

It is somewhat difficult to know just what to say about a book like this, in which the fundamental axiom of biology, "omne vivum ex vivo," is boldly challenged—moreover, a book written, not by a dabbler, but by a trained man of science, and a Fellow of the Royal Society to boot—and in which the author sets out in detail the methods and results by which he has proved, to his own satisfaction, at any rate, that under certain conditions, living organisms arise from dead and even inorganic matter by spontaneous generation.

As the question of spontaneous generation, or abiogenesis, is usually regarded nowadays as a matter of purely historical interest, and as the author of this book has not dealt with the earlier history of the question, it may be worth while to consider this. Briefly, the doctrine of spontaneous generation was held by the ancient naturalists from Aristotle onwards, and after being severely shaken by Redi in 1668, was revived by Needham in 1748, still more severely shaken by Spallanzani, Franz Schultze, and Schwann between 1775 and 1837, revived again by Pouchet in 1859, and finally (as most biologists hold) disposed of altogether by Pasteur and Tyndall between 1860 and 1876.

For at least two thousand years, from Aristotle (325 B.C.) to Redi's time, it was firmly believed that rats and mice were "begot of the mud of Nylus," dew gave rise to insects, worms were generated in cheese and timber, beetles and wasps in dung, and so on; though from time to time there were those who had their doubts about all this, like Sir Thomas Browne. Until Redi made his simple and crude experiments, apparently no one had attempted to test the truth or otherwise of spontaneous generation. Redi exposed meat in jars, some left open, others covered with parchment and others with fine wire gauze. The meat in all the jars became spoiled, of course, and flies, attracted by the smell, laid their eggs in that left uncovered, a crop of maggots arising therefrom; in the case of the covered vessels the flies laid their eggs on the gauze but no maggots appeared on the meat itself. Redi concluded that all supposed cases of spontaneous generation were due to the introduction of living germs from outside. Huxley remarks of Redi's work, "the extreme simplicity of his experiments, and the clearness of his arguments, gained for his views and for their consequences almost universal acceptance."

So far as larger organisms were concerned, therefore, Redi may be said to have settled the question of biogenesis *versus* abiogenesis. Soon after Leeuwenhoek discovered the existence of bacteria, in 1687, spontaneous generation was again invoked—this time in order to account for the origin of microscopic organisms. The first experimental test, apparently, was made by Needham (1748), who extracted meat-juice by boiling, enclosed it in vials which he corked and sealed, then heated the sealed vials and set them aside; in course of time the juice was found to swarm with bacteria, and as Needham believed he had killed all living germs in the juice by repeated heating, he concluded that the organisms had arisen by spontaneous generation. Spallanzani, in 1775, first made use of narrow-necked glass flasks in the experimental study of the question, arguing that Needham's methods were careless and insufficient, and that it was better to use vessels which could be hermetically sealed. Spallanzani worked with scrupulous care and precision, placing vegetable infusions and meat juice in his flasks, sealing the necks in a flame, and immersing the flasks in boiling water for about an hour in order to destroy any germs that might be already present. His infusions remained unchanged, and he drew the obvious conclusion that even microscopic organisms are not spontaneously formed in nutrient fluids. Needham objected to these results, maintaining that prolonged boiling would destroy not merely germs but also the "vegetative force" of the infusion itself; but Spallanzani easily disposed of this objection in his later experiments by showing that when the infusions were again exposed to the air, no matter how severe or prolonged the boiling to which they had been subjected, the organisms appeared.

Now we come to what, until the appearance of Bastian's books, was generally considered to be the final phase in this controversy. The discovery of oxygen by Priestley in 1774 gave rise to doubts as to the conclusive nature of Spallanzani's work—oxygen, it was argued, is necessary for active life, and the boiling of the flasks might have driven out the oxygen. Hence it became necessary to experiment under conditions in which the nutrient fluids are made accessible to the atmosphere. Franz Schultze in 1836, and Theodor Schwann in the following year, devised apparatus in which air was drawn through sulphuric acid, or heated strongly, on its way into the nutrient fluid; both of these experimenters took care to have their flasks and fluids thoroughly sterilised, and their experiments showed that the latter remained uncontaminated. Once again, however, the question was opened up, by the publication in 1859 of Pouchet's experiments; but Pasteur's brilliant researches of 1860 and succeeding years proved that, ingenious though Pouchet's experiments undoubtedly were, they were marred by several sources of error—that is, he had left several loopholes for the entry of germ-laden dust into his fluids. Finally, in 1876 Tyndall made his classical and crucial tests with "optically pure" air, and—at any rate for the majority of biologists—the doctrine of spontaneous generation was ejected from its last stronghold.

As remarked by Locy ("Biology and its Makers," 1908), the work of Pasteur and Tyndall "showed that under the conditions of the experiments no spontaneous origin of life takes place. But while we must regard the hypothesis of spontaneous generation as thus having been disproved on an

experimental basis, it is still adhered to from the theoretical standpoint by many naturalists; and there are also many who think that life arises spontaneously at the present time in ultra-microscopic particles. Weismann's hypothetical 'biophors,' too minute for microscopic observation, are supposed to arise by spontaneous generation. This phase of the question, however, not being amenable to scientific tests, is theoretical, and therefore, so far as the evidence goes, we may safely say that the spontaneous origin of life under present conditions is unknown."

Dr. Bastian's claims are not likely to meet with much sympathy, or any acceptance from the majority of biologists. Still, one may admire his courage in publishing at the present day a circumstantial account of experiments in which he claims to have proved conclusively that not only bacteria and "torulae" (obsolete term for saccharomycetes or yeasts), but even ascomycetous fungi (penicillium — with full-grown mycelium, gonidiophores, and all!), appear *de novo* in absolutely sterilised solutions. The mystified reader may well exclaim, in the language of Truthful James (slightly paraphrased)—"Do I sleep? Do I dream? Do I wonder and doubt? Are things what they seem? Or is visions about? Is our bacteriology a failure? Or is pasteurisation played out?"

Without attempting a detailed analysis of this remarkable book, we should like to mention for the consideration of the numerous readers who are always attracted by the heterodox and the startling, in science as in all other branches of thought, a few of the many points arising from a perusal of this heterodox and startling volume. It is generally agreed that the yeasts have arisen—by reduction and by adaptation to life in, and fermentation of, saccharine solutions—from higher ascomycetes, that is to say, from a highly-organised group of fungi, which has unquestionably had a long phylogenetic history. Yet these organisms are said by the author to arise *de novo* and in abundance in sterilised solutions containing no trace of organic substance of any kind. It is not quite certain from which particular group of ascomycetes the yeasts have actually arisen; but in any case our amazement is not lessened when we learn that an ascomycetous fungus, the familiar and ubiquitous penicillium, is also regarded as an organism which suddenly appears in the same way in absolutely sterilised inorganic media. Now, botanists are generally agreed that the ascomycetous fungi have most likely arisen from the red algae, and that penicillium has doubtless passed through an even longer evolutionary history than the yeasts. If the author's observations could be proved, we should have proof not merely of spontaneous generation but also of *evolutio per saltum* with a vengeance—mutation of a kind far beyond the wildest dreams of the mutationists. The organisms which are supposed to have arisen by spontaneous generation in Bastian's cultures, it should be noted, are just those which are the bane of the careless bacteriologist—bacilli, yeasts, penicillium, and so on.

We should like to see experiments like those described in this book done on a large scale—if they can be done in small vials and flasks, why not in huge vessels containing a few hundred gallons of the sterilised solution? It would then be possible to test the author's claims in a simple and conclusive manner—the organisms could be separated from the solution and chemically analysed. The author states, by the way, that he used pure solutions of sodium silicate. If it could thus be absolutely proven that the solution was entirely free from the slightest traces of carbon, nitrogen, sulphur, and phosphorus, the crucial question would be—do the "abiogenetic" organisms contain these elements, which we have hitherto regarded as universal and essential constituents of the living substance protoplasm? If they do, then we should have a result transcending in scientific interest, and more truly epoch-making than, the mere trifle of highly-organised fungi appearing by spontaneous generation in a sterilised organic infusion. Perhaps, however, it would not be necessary to work upon such a large scale—though the idea of so doing appeals to us, on the principle of eliminating "experimental error," as strongly as did that of estimating the frequency of butting of bull-calves to the professor of physiology in "The Food of the Gods"! A skilful chemist could easily settle the question by a series of microchemical tests. But apparently these, and various other, aspects of the matter did not occur to the author of this remarkable work.

The fact is, that with every intention of judging the author's results and interpretations in a candid and unbiassed spirit, we find throughout the work glaring instances of neglect to take obvious precautions and to make really scientific tests, and therefore we have no alternative but to reject these results and interpretations, as most emphatically "not proven."

F. C.

BOTANY.

The Life of the Plant.—By C. A. TIMIRIAZEFF. 355 pages. 83 illustrations. 9½-in. × 5¾-in.

(Longmans, Green & Co. Price 7/6 net.)

This book has been translated from the seventh Russian edition by Miss Anna Chéréméteff, who deserves the warmest praise for the arduous task which she has so skilfully and successfully undertaken. Our sole regret is that this admirable work was not long ago done into English—it was first published in Russian in 1878. We have for years sought in vain for a French or German edition, and not having been able to learn of any translation had almost resolved to learn Russian in order to peruse what we felt sure must be an exceptionally interesting book, worthy of the high reputation of the author as a plant physiologist! The perusal of this belated English version has more than confirmed our expectations, for this is a work of the highest interest for teachers and students of Botany. Timiriazeff's researches, in particular those on chlorophyll and photosynthesis, have become classical, and that he is a master of the art of exposition is shown in his Croonian Lecture to the Royal Society in 1903 on "The Cosmical Function of the Green Plant" (*Proc. Roy. Soc.*, vol. 72, 1903, pp. 424-461).

The book is based on a course of semi-popular lectures delivered in Moscow during the winter of 1876, and are written in a delightfully free, in places colloquial and even humorous, style which makes them exceedingly good reading. The introductory portion of Chapter (or Lecture) I. contains some pointed and pithy remarks on the general public's meagre knowledge of botany (for which, as the author very justly says, the fault lies partly with botanists themselves and partly with the historic development of this branch of science) and the two old-fashioned types of botanists, the "pedantic nomenclator" and the amateur horticulturist or "elegant adept of the *amabilis scientia*, as botany was called in olden times," both of whom are still "botanists" to the public of to-day, including even well-educated people not conversant with science. Equally enjoyable are the author's gentle sarcasm concerning the type of botanical work which is "hackneyed and suitable only for children's books or for occasional illustrated publications for grown-up people"; his gibes at the botanical marvels and absurdities appearing now and then in the daily newspapers; his reflections concerning the backward condition of vegetable physiology as compared with morphology, and the reasons for this; and the interesting comparison which he draws between the historical development of animal physiology and that of vegetable physiology; and so on.

After this stimulating introduction, the author proceeds to the consideration of the general structure of plants, the cell, seeds, roots, leaves, stems, growth, flowers, the relation between plants and animals, and the origin of organic forms; and in an appendix gives an account of "the plant as a source of energy," which is on similar lines to his Croonian Lecture already referred to.

Throughout, the idea expressed in the title—"the life of the plant"—is kept consistently to the front, and many experiments (some of them exhibiting extreme ingenuity) are described. Most of these experiments were shown to the fortunate audience attending the author's course of lectures, over which he must have taken infinite pains—and which he evidently delivered with great gusto.

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Without entering upon a detailed analysis, it may be said that this book is one which will not only be read with pleasure and profit by botanical teachers and students, but is one of the very few comprehensive botanical works which can be recommended to the educated reader whether or not conversant with botanical science. Of all recent botanical publications in English, this is *the* book for general readers who want something better than the "talky-talky" and "pretty-pretty" sort of "popular Botany," something that will (without either being above their heads or insulting their intelligence) give them such an insight into plant-life as can only be given by a writer who has himself contributed notably to the advancement of his chosen branch of science and who also possesses in a marked degree the happy facility of imparting his knowledge in a clear and graceful style.

F. C.

Botany.—By MARIE STOPES. 94 pages. 5 figures. 6½-in.×4¼-in.

(T. C. & E. C. Jack. Price 6d. net.)

This is one of the remarkably cheap little "People's Books" introduced by Messrs. Jack. To compress into ninety pages a general account of the several divisions of "Botany, or the modern study of plants"—morphology, anatomy, physiology, ecology, palaeontology, and so on—is a formidable undertaking, and the authoress may be congratulated on having attempted the almost impossible and done it successfully. In less skilful hands, the result might have been somewhat incoherent and unreadable, but this little book is extremely readable, and gives an admirable bird's-eye view of the subject-matter and aims of the various branches into which botanical science has for convenience been necessarily divided. It will form an excellent general introduction to works in which these various departments are dealt with by specialists. There are a few slight inaccuracies and obscure statements; for instance, the tendrils of ampelopsis are branches (modified inflorescences), not leaves, and the name of the remarkable pitcher-plant which provides its own flower pots is misprinted *Discidia*, for *Dischidia*. Instead of printing on a separate slip the introduction in which the authoress tersely describes the scope and aims of her little book, the publishers might either have incorporated it in the book (the reader can, of course, remedy this defect by the aid of a paste brush) or have printed on the title-page as a suitable motto a slight adaptation of Juvenal's "quicquid agunt *botanici* nostri farrago libelli."

F. C.

A Manual of Structural Botany.—By HENRY H. RUSBY. 248 pages. 599 illustrations. 9½-in.×6-in.

(J. & A. Churchill. Price 10/6 net.)

The author states in his preface that this volume "which is a condensed but fairly complete introduction to Botany, and is suitable as a text-book for academic or collegiate students, has been written with special reference to the needs of the first year student of pharmacy, as a preparation for his second year work in pharmacognosy." From the high official positions held by the author in the American pharmaceutical world, we may infer that the curriculum outlined in this book represents the kind of botanical course which is considered necessary and sufficient for the American student of pharmacy. If so, we may congratulate ourselves that in this respect at any rate we are far ahead of our American cousins and have nothing useful to learn from them. Judged as a "fairly complete introduction to Botany," this is probably the most tedious, arid, stodgy, pedantic, uninspiring, stale, flat and unprofitable work published in modern times. Had the work been entitled "A Dictionary of Botanical Terms," it would be a very different matter, for it certainly gives a wonderfully complete collection of terms, with explanations and diagrams. It would be difficult to think of a single descriptive term in the fearsome vocabulary accumulated since the days of the mediaeval herbalists which cannot be found in this volume. Imagination staggers at the picture of the American pharmacy student's task of mastering this "fairly complete introduction to Botany," with blood-shot eyes and a splitting headache which no wet-towel applications can assuage. Surely even a pharmaceutical student should be taught that Botany is Plant Biology—the study of the life of plants. This high-and-dry morphology and terminology, with hardly even a passing reference to function and life-processes, cannot be accepted as the right sort of botanical curriculum for any class of student, whether he be preparing for a medical or pharmaceutical diploma or taking the subject as part of a general training in science or arts. Surely the best course of botanical work for every purpose is one in which form and function are studied hand in hand and recognised as mutually explanatory. Of course, to understand the physiology of plants it is necessary to study their form and structure, just as it is essential to study the construction of a machine in order to understand aright its working; but, on the other hand, the study of plant organs apart from their functions is, like the study of the parts of a machine without any reference to their uses, a tedious and fruitless pursuit. The attempt to study the plant exclusively from one or other of the two arbitrary points of view of morphology and physiology is not merely illogical—it cannot even be strictly applied or carried to a logical conclusion. Still, this impossibility is occasionally attempted, as in the present work.

However, while protesting against the claim of this type of botanical text-book to be regarded as a "fairly complete introduction to Botany," one may recommend it as a work of reference and as a morphological treatise which may be useful as an adjunct to works in which plant-life is treated from the biological point of view.

F. C.

CHEMISTRY.

Electro Analysis.—By E. F. SMITH. 332 pages. 46 illustrations. 7½-in.×5-in.

(Kegan Paul & Co. Price 10/6 net.)

The simplicity, rapidity and accuracy of electrolytic methods of analysis would naturally appeal to the American mind, and it is therefore not surprising that a large proportion of these processes should have been worked out in America. Professor Smith is well known for his contributions to this branch of chemical analysis, and the present book, which has deservedly reached its fifth edition, embodies much of his work upon the subject; while the reader has the advantage of knowing that all the methods described have been given a practical trial by the author. The new material in this edition includes all the important processes and modifications that have been published in scientific journals during the past four years, including the methods for the electrolytic separation of the alkali metals. There is a good index, but the references to the original papers are somewhat scanty.

C. A. M.

A First Year Physical Chemistry.—By T. P. HILDITCH, D.Sc. (Lond.), F.I.C. 176 pages. 57 illustrations. 7½-in.×5-in.

(Methuen & Co. Price 2s.)

Although several books dealing with the physics of chemistry have recently been published, we are not acquainted with any that covers quite the same ground as this useful little manual. While it is essentially intended for the work of a first year course in chemistry it is yet quite advanced enough for the use of those who are working for "Intermediate Science" examinations. Even in the more abstruse parts the text is simply expressed and is not too didactic. Practical work goes hand in hand with theory, and the experiments are well chosen and described, and wherever there was likely to be any want of clearness, diagrams of the apparatus are given.

The book will be found of the greatest assistance by all who are beginning the study of chemistry, and should be used as a companion to the ordinary elementary text books.

C. A. M.

Organic Chemistry.—By W. H. PERKIN, Sc.D., F.R.S., and F. S. KIPPING, Sc.D., F.R.S. 664 pages. 7¼-in.×5-in.

(W. & R. Chambers. Price 7/6.)

Many generations of students have availed themselves of the valuable help of this well-known textbook, and the present

reviewer has, on several occasions, recommended it as one of the most suitable books as introductory guide to organic chemistry. In many respects the present edition may be regarded as a new book; for it has been thoroughly revised and brought up to date, so as to include the results of the most recent work in this branch of the science. At the same time the plan and character of the work have been kept, so that while the book will now be more helpful to advanced students and for those studying medicine, it still remains an excellent guide for the beginner.

As in the former editions practical work is given its due position, and numerous experiments are described in illustration of the theoretical matter. Practical applications of chemical reactions are also described in brief outline, and usually in sufficient detail for the purpose in hand.

We have noticed very few slips, but are the authors correct in stating on page 172 that fatty acids containing an odd number of carbon atoms do not occur in nature? Within the last few years it is claimed that several such acids (*e.g.*, daturic acid) have been discovered.

C. A. M.

Organic Chemistry.—By J. E. COHEN, B.Sc., F.R.S. (The People's Books). 96 pages. 4 illustrations. 6½-in.×4½-in.

(T. C. & E. C. Jack. Price 6d. net.)

Professor Cohen has undertaken a most difficult task in attempting to compress into a little book of ninety-six pages the whole subject of organic chemistry in such a way that it may be understood by anyone without special chemical knowledge.

Although parts of his book will answer to this requirement, we cannot help feeling that in other places he is unnecessarily abstruse, and also goes into too much detail. For instance, on page 21, a table of the physical properties of homologous hydrocarbons is given, whereas it seems to us that the space might have been better utilised (for the end in view) with a fuller explanation in simple language of the meaning of the term *homologous*.

Outlines are given of some of the principal industries based on reactions in organic chemistry and, in general, these are clear and accurate. It is a pity, however, that the author has fallen into the usual mistake about vinegar-making, and has described incorrectly an obsolete method.

Regarded as a summary for the student of chemistry, the book is admirable, and the price at which it is published in an attractive form is a matter for wonder.

C. A. M.

GEOLOGY.

The Natural History of Clay.—By A. B. SEARLE. Cambridge Manuals of Science and Literature. 176 pages. 18 illustrations. 6½-in.×5-in.

(The Cambridge University Press. Price 1/- net.)

The term clay is of popular origin and use, hence its adoption as a scientific term is attended with some little confusion, owing to the great number of possible definitions, all of which are to some extent unsatisfactory. While everybody knows what clay is, it seems impossible to frame a satisfactory definition. Even plasticity is not an invariable property of clay, for some kaolins are devoid of this character. The author of this excellent little manual objects to clay being described as a "mineral," except in a legal sense; but there is no doubt that the word "mineral" is the old, popular and scientific term for any inorganic natural substance. We agree, however, with the statement (page 3) ". . . . . clay is not a mineral, but a rock," if, for "mineral," "mineral-species" is substituted.

The book is about evenly divided between the technology and the geology of clay. The technology of clay is a complex and difficult subject, but the author shews himself perfectly at home in it, much more so than in his geology. A clumsily-worded paragraph on page 52 might lead a reader to suppose that a Carboniferous Limestone clay could be accumulated by the denudation of Coal Measures. The table of "the chief clay rocks, arranged geologically," at the beginning of the book, does not convey much information and might advantageously have been extended.

There is a valuable concluding chapter on the nature of the ultimate clay-material. As the author shows, no finality is yet reached in this difficult problem. There is an irritating multiplicity of uses of the term "clay" in this chapter. Sometimes it means a geological unit, sometimes "true clay" or the mysterious clay-substance, "clayite," or "pelinite." A characteristic example of this confusion occurs on page 139. Many of the terms, however, are concisely defined later on (page 149).

A short bibliography of the more important works on clay, and an adequate index, are provided. This little book may be recommended to all interested in the technological or geological aspects of clay as a concise and well-written introduction to the subject.

G. W. T.

Stanford's Geological Map of Central Europe. 16½-in.×10½-in. Scale, 1 : 6,336,000.

(E. Stanford. Price 5/-.)

This is a geological map of a part of Europe, reduced from the Carte Géologique Internationale de l' Europe on a scale of one hundred miles to an inch. It includes the region between North Germany and Sardinia, and between Ireland and Hungary. In the colouring all the igneous rocks, of whatever age, are lumped together; as are also the metamorphic. Cambrian and Ordovician, Upper Silurian and Devonian, Carboniferous and Permian, respectively make groups to which one colour is assigned. The terms Ordovician and Upper Silurian are, or should be, mutually exclusive. One should have either Ordovician and Silurian, or Lower and Upper Silurian. Objection might also be taken to the term Broverian as of too local significance to be used to designate the sedimentary series below the Cambrian. The map will be useful for purposes of broad stratigraphical comparison.

G. W. T.

Mineralogy.—Fourth edition. By F. H. HATCH, Ph.D., F.G.S. 253 pages. 124 illustrations. 7½-in.×5-in.

(Whittaker & Co. Price 4/- net.)

This fourth edition of a popular text-book has been entirely re-written and much enlarged, and is, to all intents and purposes, a new book. A text-book of mineralogy falls naturally into two parts; one dealing with the properties of minerals in general, the other descriptive. Dividing his book in this way, Dr. Hatch deals with the morphological, physical, and chemical characters of minerals in an admirably lucid way considering the complexity and difficulty of presentation of the subject in a small compass. The crystallographical chapter is exceedingly compact and understandable. The trigonal sub-system, however, might have been mentioned when dealing with the hexagonal. Moreover, its most important form, the rhombohedron, is only mentioned in connection with the obsolete conception of hemihedrism, which is retained in the book.

In the descriptive part the minerals are arranged under the heads of rock-formers, ores, salts, and gems. This classification, as the author admits, is not free from inconsistencies, but nevertheless seems to have a practical value and convenience in teaching. A good index makes it easy for the student to look up any particular mineral, notwithstanding its possibly anomalous place in the classification.

G. W. T.

The Mineral Kingdom.—By DR. REINHARD BRAUNS, translated, with additions, by L. J. SPENCER, M.A., F.G.S. Parts 17–20. 56 pages. 39 illustrations. 12-in.×8¾-in.

(Williams & Norgate. Price 2/- net per part.)

These four recently published parts of this fine work maintain the standard set up by the earlier parts. They are mainly concerned with the rock-forming minerals, the felspars, felspathoids, zeolites, pyroxenes, amphiboles, and micas. Some mention might have been made of the now well-ascertained occurrence of primary analcite in igneous rocks, with the consequent recognition of a series of analcite-rocks analogous to those characterised by leucite and nepheline respectively.

Numerous beautiful plates, some in colour, are issued with

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these parts. The treatment is, of course, "popular," but the specialist may gain much by consulting this concise and finely illustrated epitome of mineralogy.

G. W. T.

PSYCHICAL RESEARCH.

The Trend of Psychical Research.—By H. A. DALLAS. 49 pages. 6-in. × 4¾-in.

(John M. Watkins. Price 6d. net.)

During the thirty years that it has been established, the Society for Psychical Research has accumulated a vast number of facts in the obscure domains of psychology, distinguishing the genuine phenomena from the tricks of "spiritistic" charlatans, thus rendering valuable scientific service to the world. But as Miss Dallas (who is a well-known investigator of these matters) argues, the business of science is not merely to collect data, but also to frame theories in explanation of them. She thinks, and most persons who have studied the subject will agree with her, that the time has now arrived when certain conclusions may be drawn from the data already obtained. These conclusions she formulates as follows:—

"1. The reality of an unseen universe of intelligent life.

2. Man's survival of bodily death.

3. That communication takes place between the (so-called) living and the (so-called) dead."

In the essay under review, which was originally delivered as a lecture to the Quest Society and has been reprinted from *The Quest*, she briefly states some of the evidence upon which these conclusions are based. It is of a most interesting nature, and the writer's arguments are well (if of necessity briefly) put.

H. S. REDGROVE.

ZOÖLOGY.

The Life and Love of the Insect.—By J. HENRI FABRE, translated by ALEXANDER TEIXEIRA DE MATTOS. 262 pages. 12 plates. 8-in. × 5¼-in.

(Adam & Charles Black. Price 5/- net.)

A great love of nature, an aptitude for painstaking and ingenious research, as well as the power of writing a pleasing description belong to M. Fabre, and all three have been combined to produce the essays which make up this volume. The subject of dung beetles does not at the outset sound inviting, but M. Fabres' account of the sacred beetle and its work, as well as that of the Spanish *Copris* and *Minotaurus typhaeus* is most interesting and delightful. Beetles are not by any means the only creatures dealt with, for the scorpion's courtship is described, as well as the habits of some solitary wasps and bees. The ringed *Calicurgus* should be specially mentioned, which first stings its spider-prey in the mouth in order to paralyse the fangs, and then in the body to keep the legs still. M. Fabre digresses to describe Pasteur's call upon him previous to the investigations which the great bacteriologist made on silkworm disease. At that time Pasteur had never seen the cocoon of a silkworm nor did he know that there was a chrysalis inside. We are kindly permitted by Messrs. Black to print one of the illustrations (see Figure 292).

W. M. W.

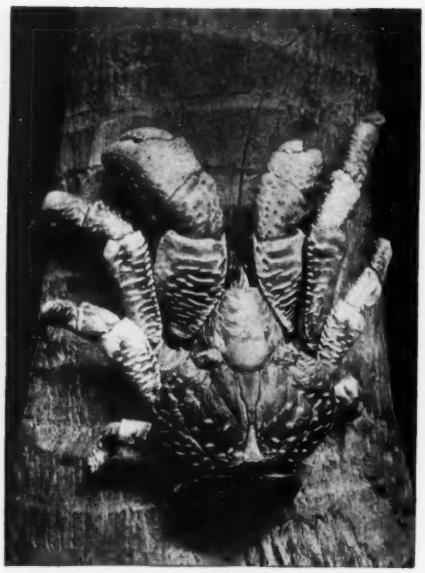


FIGURE 291.
A Tree Crab, from "The Life of the Crustacea."

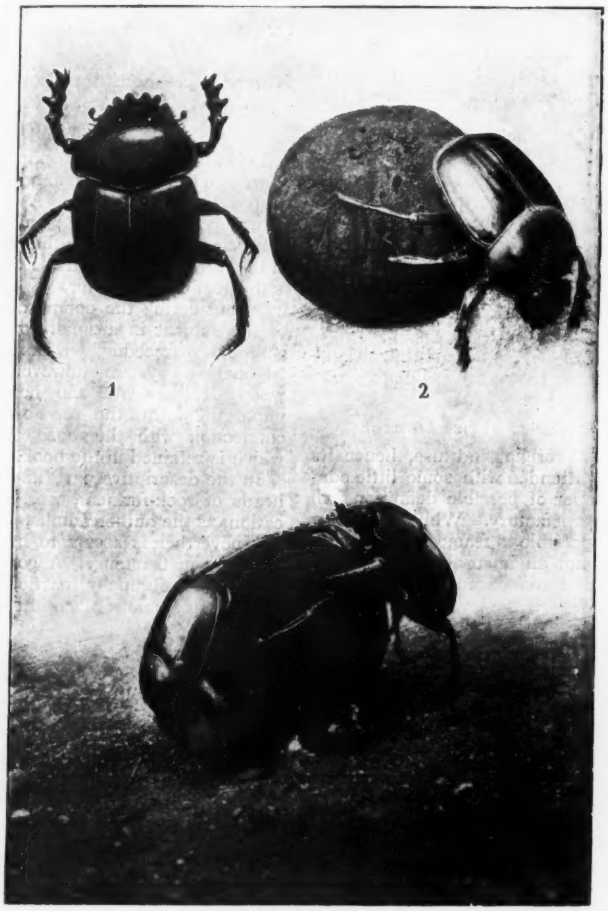


FIGURE 292.
The Sacred Beetle, from "The Life and Love of the Insect."

The Life of the Crustacea.—By W. T. CALMAN, D.Sc. 289 pages. 85 figures. 7¾-in. × 5¼-in.

(Methuen & Co. Price 6/-.)

Dr. Calman has produced a truly scientific, but at the same time, an eminently readable book, and this because he has picked out from the wealth of his information with regard to Crustacea many points which are of general interest. Some specialists are not capable of doing this, which is a pity, for one of the important ways of advancing any particular branch of science is by attracting new workers into the field. In "The Life of the Crustacea" we are told of Crabs which use a shield, such as the valve of a shell or a mangrove leaf, and carry it about; of forms which rear their young in a brood pouch like the opossum shrimp and the wood-lice; of hermit crabs that live, not in the coiled shell of some dead mollusc, but in a piece of hollow water-logged stem, and are quite symmetrical; not to mention such little-known species as the well-shrimps which dwell in subterranean waters. These and many other subjects are attractively brought before us with the help of some excellent illustrations (see Figure 291, which is reproduced by the courtesy of the Publishers). The question of parasites and messmates

is considered, and a chapter added on the economic side of the Crustacea.

W. M. W.

Sea Fisheries, Their Treasures and Toilers.—By MARCEL A. HÉRUBEL, Doctor in Science and Professor at the Institut Maritime. Translated by Bernard Miall. 366 pages. 9-in. × 6-in.

(T. Fisher Unwin. Price 10/6 net.)

We welcome this excellent translation of a valuable book. M. Hérubel has given us a vividly interesting account of the rapidly growing department of applied science which deals with sea-fisheries,—with an industry that represents more than £10,000,000 a year in Britain alone. With great skill he has brought together the physical, biological, and economic facts on which sound practice and secure progress must rest. And while he is very generous to British organisation of fisheries (and our faculty of uniting tradition and progress), those who can read the book without realising something of the possibilities of further development must be either very self-complacent or very dull. M. Hérubel writes in a masterly way, but with a light touch, of food-fishes, fishing-grounds, oceanic feeding grounds, factors of destruction, fishery laws, re-population, fisheries and science, fishery problems, the social life on the coast, fishing ports, boats and gear, the fishermen, the markets, the outlets, the financial aspect, the humane aspect, the possibilities ahead. But this indication of the contents of the book can give but a faint idea of its interest. The author writes with a full knowledge and with a wide outlook, and scientific as he is, he has not been able to shut out the glamour and sparkle of the sea from his discourse.

J. A. T.

The Animal World. — By F. W. GAMBLE, F.R.S. 255 pages. 36 illustrations. 6¾-in. × 4¼-in.

(Williams & Norgate. Price 1/- net.)

The big text book, it has been said, is out of date before the last sheets have been printed off, and hence the advantage of attending lectures given by a teacher who has to keep abreast of the times. The present volume of the Home University Library certainly fulfils its object and enables one to learn what are the present opinions upon a number of biological matters. Several of Professor Gamble's chapters are particularly interesting, as, for instance, that upon the Colours of Animals. The explanation that the markings which cause an animal to be practically invisible save it from its enemies, is put down as being futile, but the reader must not let the little joke that "protection in animal as in human economies is thought to meet the needs of the time" make him forget that no arguments are brought forward. Those who have only scraps of leisure should carry Professor Gamble's suggestive little book in their pocket and read it at odd moments.

W. M. W.

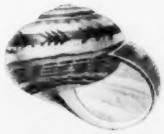


FIGURE 293.
Helix pisana.

FIGURE 294.
Helix pisana on its food plant.

Monograph of the Land and Freshwater Mollusca of the British Isles.—By JOHN W. TAYLOR. Part 19. 48 pages. 63 figures, 4 plates. 10¼-in. × 6¼-in.

(Leeds: Taylor Bros. Price 7/6.)

The latest part of this monograph completes the account of *Helix pisana* which was just begun in Part XVIII and deals also with *Helicigona lapicida*. The plates, which are more numerous than usual, show coloured representations of Hyliana and Zonitoides, which is included to help bring up the arrears as well as variations in colour and size of *Helix pisana* and its distribution. We notice that there is a figure labelled *H. pisana* var. *grasseti* from the Canary Islands; but judging from specimens which the Rev. R. Ashington Bullen recently found in the same locality, and exhibited alive before the Malacological Society, it would appear that this form should be considered a distinct species. As usual, considerable attention is given to the anatomy of the species described as well as to their habits and geological and geographical distribution. By the courtesy of the author we are able to give an example of the black and white drawings of the shell (see Figure 293), as well as to reproduce the picture of *Helix pisana* congregated on its food plant at Tenby. The species is interesting, because in the British Islands its range is restricted to South Wales, South-West England and to Ireland. The species has, however, a wide range in France, Spain, Italy and the North of Africa, and so on, as will be seen from Figure 295, for which we are also indebted to Mr. J. W. Taylor. In conclusion, we would say that the plates are most excellently reproduced, while Mr. Taylor still continues to use every endeavour to deal fully with each species. If we have any criticism it is that the parts do not appear as quickly as we should like, and that descriptions of many so-called varieties might be omitted

W. M. W.

FIGURE 295.
The Geographical distribution of *Helix pisana*.
Black = recorded distribution. Hatching = probable distribution.

CORRESPONDENCE.

LIGHTNING FLASHES.

To the Editors of "KNOWLEDGE."

SIRS,—I send herewith five prints of lightning flashes which I was fortunate enough to secure during a thunderstorm of unusual severity, for this part of the Kingdom, on 9th-10th August last.

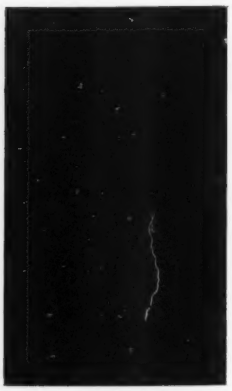


FIGURE 296.

Beaded Lightning. Flashes meeting.

In the November issue of "KNOWLEDGE" there was an article and sketches of a storm at Garessio, Italy, which was interesting to read of, and would have been more so had the sketches been photographs, because, in the light of what I have got myself, I do not see how Mr. Parkinson's eye could have taken in and followed the outlines of the *five* streaks, which he shows in his first sketch.

I annex a short description of the storm, with details of the various points noticeable on the photographs, which may be of interest to readers.

The thunderstorm, during which the photographs here reproduced were taken, occurred on the 9th-10th August, 1911, and, in Scotland at any rate, covered a line or belt of about twenty or thirty miles in width. At Dumfries and at Lauder, Berwickshire, it was seen to the eastward; then it seems to have passed right up the east coast of Scotland, being very near at St. Andrew's, Arbroath, Stonehaven, Aberdeen. At Elgin it passed to the eastward, but so far away that little, if any, thunder was heard.

At Stonehaven, Kincardinshire, where the photographs were taken, there were two distinct storms. The first storm commenced about 9 p.m., lasting till about 10.30 p.m., when it passed over and to landward of the town. About 11 p.m. the second came up, lasting till 2 a.m., and passing entirely seaward. From 9 to 10 o'clock no rain fell.

I had read, some weeks previously, that "in photographing lightning it is necessary beforehand and in daylight to focus the camera as for a distant view, and to mark on the baseboard where the pointer stops." This, fortunately, I had done. The camera was stationary and pointed southward.

FIGURE 298.

Beaded Lightning.

FIGURE 297.

Flash from cloud to cloud.

In Figures 296, 297, and 298, the lightning flashes coming from quite different parts of the sky all meet earth (or possibly the sea) in exactly the same spot on the horizon. They might not, however, all do so if seen at right angles to the present view.

Figure 297 is rather a curious flash from cloud to cloud and then to earth.

In Figure 299 the flash ramifies only near to the horizon.

Beaded lightning is seen in Figures 296 and 298.

Figures 296, 297, and 298 were probably taken in this order, though I have no note of it, and Figures 299 and 300 show the storm passing to landward.

Any make of camera would, of course, do for the subject, with the shutter open at its largest aperture, and the same would apply to the plate, as long as it was not too slow. In this case I used Kodoid Cut Films, and developed them in a tank with diluted developer.

H. HARGRAVE COWAN.

ELGIN, SCOTLAND.

MISCELLANEOUSOBSERVATIONS, 1912.

To the Editors of "KNOWLEDGE."

SIRS,—I should like to report to you the following miscellaneous astronomical observations made here by means of a three-inch equatorial refractor since the beginning of the year 1912.

1912, March 5th, about $8^h\ 27^m$ C. S. T., a bright, rapidly moving telescopic meteor was observed to traverse the eighty-four-diameter field of my three-inch refractor. The meteor did not consist merely of a streak, but resembled more nearly a band of light, especially when it disappeared at the *f.* end of the field of view, where the end of it seemed to grow slightly larger and brighter; it moved from W. to E. and required somewhere in the neighbourhood of one or one and one-half seconds to pass entirely across the eighty-four power field; it was white in color, the light being not intense, but rather soft. This meteor passed only a short distance *s.* of the star cluster M. 38 Aurigae, and in its flight traversed a small group of stars near that object.

FIGURE 299.

Flash ramifying near the horizon.

The occultation of τ Arietis by the Moon, at $7^h\ 56^m$ C.S.T., on 1912, March 22nd (*Nautical Almanac*, 1912), was witnessed with great interest. Some ten minutes before the phenomenon took place, happening to point the telescope at the Moon I discovered that an occultation of that star was imminent. At the precise moment of ingress the star was instantly cut off from view by the Moon's limb. The whole sight was very pleasing, especially as the star was of magnitude 5·1, and sufficiently bright to remain easily visible in the strongest glare of our satellite; the Moon was then a thin crescent, the occultation occurring on the dark side. A few fainter stars were in the same field. Forbidding local conditions prevented an observation of the egress of τ Arietis from behind the Moon's disc, but instead another little star near by was seen to practically graze the *s.* limb of the Moon, at its closest being only about 20″ *s. p.*, from the limb. This strange phenomenon took place very soon after the predicted occultation.

FIGURE 300.

Storm passing to landward.

Mercury was observed on 1912 March 24th, 27th, and 30th, on every evening being easily

perceptible to the unaided eye. It was very unfavourably placed on the 24th, when hardly anything could be made out in it through the telescope, except the colour, which was yellowish, and the general phase, the disc being then discerned to be approximately fifty per cent. illumined. The disc was at all times very small in apparent dimensions, and at no time could a power to exceed eight-four diameters be employed for studying it, while fifty-six was nearly always preferable. On the 27th it was about 0·4 illuminated, and the apparent diameter, according to *The Nautical Almanac*, was 7″·16. On March 30th, the planet was viewed to much better advantages, as it was "picked up" in strong twilight by the aid of the circles. The crescent form was nicely apparent, it on that date consisting of about 0·35 of the entire disc. The colour of the planet was golden yellow, although this might have been somewhat intensified by the low position of the body. The general color of the illumined portion of the disc was found to shade off gradually back from the terminator, it being lighter in the neighbourhood of that region than elsewhere. This shading was the only topographical feature visible on the planet (through my instrument at least), at the present elongation.

The Sun was observed on 1912, April 3rd, not under very favourable conditions, however, but as far as could be made out with the three-inch telescope, its disc was perfectly free from spots and all other phenomena.

FREDERICK C. LEONARD,
President S.P.A., M.B.A.A.

1,338, MADISON PARK,
CHICAGO, ILLINOIS, U.S.A.

HOW TO MAKE STEREOSCOPIC STAR CHARTS.

To the Editors of "KNOWLEDGE."

SIRS,—Referring to the article by Mr. A. H. Stuart in June "KNOWLEDGE," "How to make Stereoscopic Star Charts," I should be glad to know when the American firm he speaks of placed upon the market a series of Stereoscopic Star Charts. To the best of my belief the first stereoscopic views of the stars were those published by me in my "Road Book to the Stars," February, 1905. These were followed by "Six Stereograms of the Sun and Stars," which I had the honour of exhibiting at the Royal Society's Conversazione, in May, 1905, and followed again in November, 1905, by my "Stereoscopic Star Charts and Spectroscopic Key Maps," which I also exhibited at the rooms of the Royal Society and Royal Astronomical Society. As far as I could then gather no one had ever seen or heard of anything of the kind before. All these were not only printed and published by Messrs. King, Sell & Olding, Ltd., but were also reproduced as very beautiful transparencies and lantern slides by Messrs. Flatters and Garnett, Ltd. As regards this country I own the copyright, but not for America.

In *The English Mechanic*, of October 27th, 1911, Mr. A. H. Stuart, B.Sc., F.R.A.S., published a Stereoscopic Star Chart, which is obviously a copy of my Stereoscopic Star Chart, No. 12, with the small stars blocked out. The stars, as in my chart, are white on a black ground. Presumably, this was taken from the American Stereoscopic Star Charts he refers to, and if so it can easily be understood why "very few of the slides have found their way into England."

The Star Stereogram Mr. Stuart gives in June "KNOWLEDGE" is doubtless quite original, but it is calculated to convey the very erroneous idea that the distance of a star can be inferred from its magnitude.

It goes without saying that the correctness of the result in my Stereoscopic Star Charts depends upon the parallaxes upon which they are based being right. I had to do the best I could with the material I could collect. In twenty or thirty years time much more reliable data will be available, and then Stereoscopic Star Charts made by my method will be very valuable. Therefore, it is certainly desirable that others should be able to use it, when there are plenty of good parallaxes and proper motions.

TENBY. T. E. HEATH, F.R.A.S.

SEA SICKNESS.

To the Editors of "KNOWLEDGE."

SIRS,—Without entering into a deep treatise on the subject I think I might interest some of your readers by mentioning a factor which is very little thought about, the different rhythm in the waves.

Many people are surprised to find themselves experiencing rough weather without the least sign of sickness, while at times previous they have been dreadfully sick while the weather was nothing like as rough.

Now although that can partly be accounted for by the person being in different states of health, nerves and system generally, nevertheless it is also due to the difference in the rough weather, the different rhythm of the waves. For instance, I have been in the Bay of Biscay in apparently calm sea and have been fearfully sick, because the waves were exceptionally long and not high (a wave is measured from crest to crest)—what we call a swell. And I have been in very rough weather and not sick, because the waves were high but not long, and the motion of the boat, consequently, was a quick rise and fall, quite the reverse to the previous.

That is only a broad example to illustrate my meaning. There is a lot more in it than that. It depends also on the regularity or irregularity of the rise and fall, the height and the speed of the rising and falling, and, the most important thing of all, the length of time after the ship has descended before it starts to rise again, which may be from a fraction of a second to two or three. I have noticed that certain people are specially sensitive to certain conditions of the sea or rhythm.

BIRKENHEAD. C. POTTER.

THE FACE OF THE SKY.

To the Editors of "KNOWLEDGE."

SIRS,—I am glad indeed to see that the "Face of the Sky" is now a month in advance of issue.

The want of that was the principal reason why I (in the Colonies) gave up your journal some time ago. If Dr. Crommelin would also use his remaining space to give a summary of the results attained by the observatories of the world, public and private, as regards observation of the planets during, say, the last decade, it would, I think, be a great help to amateurs.

Many amateurs have only more or less ancient history to refer to, which, considering the improved instruments of these days, would perhaps be better consigned, in a great measure, to oblivion.

VERNON, B.C., CANADA. M. INST. C.E.

QUERIES.

Readers are invited to send in Questions and to answer the Queries which are printed here.

7. INSECT ANATOMY.—I am desirous of studying the Anatomy (Internal) of the Hymenoptera aculeata, and not having time during summer, would like to know of any method of preserving insects for this purpose? H. W.

LUDDENDEN.

8. LIGHTNING. — What is the diameter of the main stem of forked lightning (*a*) between two clouds, (*b*) between cloud and earth? does the diameter vary much? what conditions such variation? W. N. F.

UPPER NORWOOD.

XUM

THE "FOURTH DIMENSION."—A REPLY.

By JOHN JOHNSTON, M.A., LL.B.

IT may be well in the first place to state briefly the arguments of Mr. Annison in his article in the June (1911) issue of "KNOWLEDGE," and these will be stated in his own words: "The basis of our argument depends on the relation between algebraical equations of two and three variables and geometrical figures of two and three dimensions. It is known, for instance, that the locus of a point moving according to the equation $x^2+y^2=r^2$ is the circumference of a circle, or, in other words, the equation is the 'law of the circle'; and similarly $x^2+y^2+z^2=r^2$ is that of the sphere; but there are an infinite number of equations of this type, each containing one more variable than the preceding one; and arguing by analogy from the first two, the next one, $x^2+y^2+z^2+u^2=r^2$, is the law of a four-dimensioned figure . . . . The fact that we are unable to form any mental image of such figures cannot be ascribed to the equations themselves, which obviously contain no reason either why they should or should not be capable of graphical representation. *Prima facie*, if some equations can be so treated, the remainder should equally admit of such treatment, and our inability to accomplish this must obviously be due to the absence of any mental picture that will satisfy the requirements of the equations."

There is no necessary connection or relationship between the numbers or symbols which we use in arithmetical or algebraical calculations—or any combinations of these—and dimensions of any kind. 1, 2, 3, 10, 10^2, x, x^2, $x^2 + y^2 = r^2$, $x^2 + y^2 + z^2 = r^2$, and any other numbers or symbols or combinations of these are simply tools which we use in arithmetical or algebraical investigations. These tools were invented long ago; throughout the ages many improvements and additions have been made; and the process is still going on. It is in a totally different sphere of thought and action that we have got our knowledge of dimensions. We, as well as our forefathers in the remote past, have observed that everything has, and must have, length, breadth and thickness. Our observation of this, and our knowledge of this, have nothing to do with calculations of any kind. We might know about dimensions though we could do no calculations, and we might be able to calculate though we knew nothing about dimensions and though there were none.

There are certain kinds of calculations which have to do with dimensions. Carpenters and engineers make calculations in reference to wood and iron, in order to manufacture what is wished. These calculations are based on measurements in the three dimensions which they have made, and the data of these calculations are what they have observed with their eyes. The fact that many of their calculations have to do with the three dimensions is not because there is any necessary relationship between calculations and dimensions, but simply because these calculations are in reference to the length, breadth and thickness of objects existing or to be made. Whether calculations have to do with dimensions or not, the numbers or symbols which we use are nothing more than tools in our hands. If we are raising numbers to powers far above the third in order to calculate compound interest by means of logarithms we do this, not because these high powers have anything in actual existence corresponding to them, but simply because this is a convenient way of making the calculation.

The equations $x^2+y^2=r^2$ and $x^2 + y^2+z^2=r^2$ may be simply numerical, or they may be, respectively, the law of the circle and that of the sphere. It is easy with a pen to insert u^2 and any number of additional symbols which we may wish. But we have not a particle of evidence that the equation with u^2 is other than simply numerical—that it has anything corresponding to it in real existence. It is not an argument by analogy that the equation with u^2 is the law of something in four dimensions; it is a pure assumption. Our knowledge that $x^2+y^2 = r^2$ is the law of the circle and $x^2+y^2+z^2=r^2$ is that of the sphere is got by experience of the circle and the sphere, and by that alone. And we have no experience of anything in four dimensions. A man in the presence of three mountains may make sketches of them on paper. He will probably be able to make a fourth sketch—somewhat similar to the others. But it would not do for him to conclude that because he made it there must be a fourth mountain. A boy may be making calculations up to the number three and may be illustrating these calculations by making three crosses on paper and by moving about three apples on a table. He will no doubt be able to make a few more crosses on the paper, but it would not do for him to conclude, "arguing by analogy," that there must be more apples on the table, and that his inability to see them must be due to some physical or mental defect. The apples have no necessary relationship with the crosses nor the crosses with the apples; nor have dimensions any necessary relationship with equations or equations with dimensions.

A correspondent in the August (1911) issue of "KNOWLEDGE" says that he believes he has been able to demonstrate, "assuming the truth . . . . of the principle of the continuity of mathematical law, that the fourth and higher dimensions do actually exist; the existence of a third dimension implying that of a fourth, and so on, to infinity." It is not a case of mathematical law at all. We have no reason to believe that, because certain mathematical expressions correspond to existing things, and because we can arbitrarily add to these expressions, the new ones must have something in existence corresponding to them. Mathematical law is consistent and continuous within its own sphere—that of calculation—but it will never enable us to discover what is or is not in actual existence. In so far as our calculations can give us knowledge as to things existing, this knowledge must be involved in the data of these calculations, and these data must be got by experience. A third dimension does not imply a fourth any more than a third apple implies a fourth on the boy's table.

Mr. Hinton—referred to by another correspondent—bases his arguments on descriptions of objects moving about or turning round. It is surely self-evident that whatever objects we take, and whatever motion we give them—backwards, forwards, rotary, or any other motion, or any combination of motions—the appearances which these moving objects present to us can give no proof, or no evidence, of the existence of another dimension. This point need not be laboured; it can be left to the readers of "KNOWLEDGE."

It may be mentioned incidentally that if Mr. Annison did not confine himself to the circle and the sphere, he would not get his basis. $x^2+y^2=r^2$ may represent a locus in three dimensions as well as one in two. It may represent a right cylinder. Also $x^2=r^2$ in three dimensions represents two planes parallel to each other and each distant r from origin.

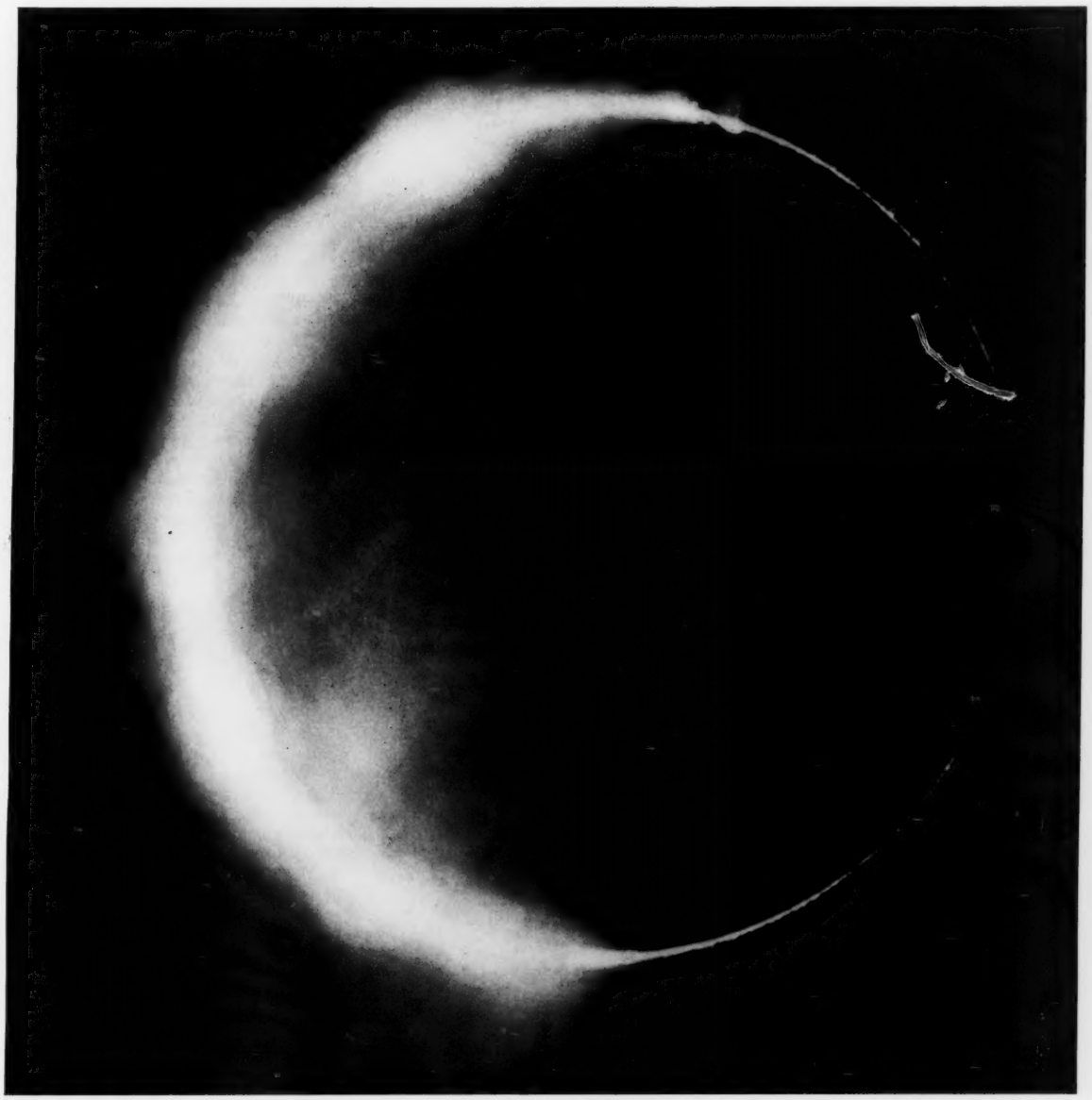
Of course, there may be a fourth dimension and many more dimensions. There may be invisible apples—of extreme tenuity—on our tables, invisible trees in our gardens, invisible cats at our firesides and invisible planets in our solar system. All that we can say is that we have no evidence of the existence of these apples or these trees or these cats or these planets or of the fourth dimension.

There is much about us that is beyond our grasp. We cannot conceive of space as being either limited or unlimited. We cannot think of a boundary beyond which space is no more. Nor can we think of space as going on—far beyond the furthest star, if there is one—for ever. Our belief in cause and effect—that everything occurring or existing must have a cause—is inconsistent with our belief in the existence of the world. We are on safe ground only when we keep within the limits of experience, or of what follows closely from the known facts of experience. If we reason too far from these facts—though our reasonings may be quite logical—we land ourselves in inconsistencies. It is worse if we leave our reason and follow our imagination instead.

NOTE ON A PARIS PHOTOGRAPH OF THE ECLIPSE.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

FIGURE 301 was obtained at the Paris Observatory, by MM. Demetresco and Crojes, with a telescope of ten metres focus placed before the siderostat. The Observatory was some twelve-and-a-half miles distant from the central line, and consequently a crescent of sunlight about 8″ in width remained uneclipsed. This appears as a confused glare in the picture in consequence of over-exposure. The thin white crescent on the other side of the moon's disc belongs to the chromosphere, not to the body of the sun. Some prominences are seen rising out of it, a large one near the bright solar crescent being especially noteworthy. The irregularities of the moon's limb break the chromospheric ring into beads in a few places. These are analogous to Baily's Beads. The part of the moon most distant from the solar crescent is seen outlined against a faint light, which is, I think the inner corona. The Paris observers are to be congratulated on obtaining such an interesting photograph.



By the courtesy FIGURE 301. The Eclipse of the Sun. *of M. B. Baillon.*

NOTES.

ASTRONOMY.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

PROFESSOR TURNER'S SUGGESTED EXPLANATION OF THE TWO STAR-DRIFTS.—Professor Turner contributed papers to the March and April numbers of *The Monthly Notices*, making a new suggestion to explain the apparent division of the stellar motions into two drifts. It has generally been assumed that a drift converging to or diverging from an apex (like a meteor radiant) indicates a series of motions along parallel paths. But Professor Turner reminds us that the same result would follow from an actual convergence of motion to a point and divergence from it. He suggests that the stars may be moving in very elongated orbits about the centre of the sidereal system, so that at any moment they may be divided into those moving inwards and those moving outwards. He gives, as an analogy, the system of comets moving round the sun; at any instant practically all of them are moving either nearly to the sun or nearly from it.

Sir John Herschel, in the "Outlines of Astronomy," briefly discussed the case of motion in spherical star clusters. Assuming the density of distribution as uniform, it is easy to see that the attraction towards the centre of the cluster is as the direct distance, and hence the stars would all describe ellipses in the same time about the centre. In actual clusters the density is not uniform; Mr. Plummer suggests a law of density found by Schuster for gases, viz., $(c^2+r^2)^{-5}$, where r is the distance from the centre and c is a constant. The form of the actual sidereal system appears to be ellipsoidal, and the density not uniform, so that the orbits would not be strictly ellipses, nor would the periods be the same for all stars. Professor Turner fixes the vertex at R.A. 94°, N. Dec. 12° as the probable centre of the system, and shows that this agrees very well with the centre (R.A. 113°, N. Dec. 22°) found by Mr. Lewis from the distribution of apparently fixed and moving binary systems. He suggests that our Sun was near the centre a million years ago, and that the period of a complete oscillation is about four hundred million years, the semi-axis major of the orbit is about six hundred light years. The crowding indicated near the centre is such that the distance between neighbouring stars there is half that from the Sun to Alpha Centauri.

While there is much that is highly speculative in these papers, they are interesting as an attempt to coördinate the results of a great many different series of observations, and as giving a readily intelligible meaning to the two stellar drifts.

Mr. Eddington has also a paper on star distribution in the March number of *Monthly Notices*. He gives a diagram of velocity distribution that brings out the two drifts very forcibly, and suggests a third drift. Deducing the distances of stars from their proper motions, he gives the following table of the average parallaxes of the stars in Boss's Catalogue (that is, roughly, the stars visible to the naked eye). Out of one hundred naked eye stars he finds that 1·0 has a parallax between ″·10 and ″·08, 1·5 between ″·08 and ″·06, 2·9 between ″·06 and ″·04, 9·5 between ″·04 and ″·02, 8·6 between ″·02 and ″·015, 17·5 between ″·015 and ″·010, 11·7 between ″·010 and ″·008, 14·9 between ″·008 and ″·006, 16·6 between ″·006 and ″·004, 10·0 between ″·004 and ″·002, 2·4 between ″·002 and ″·001. Of course, the falling off at the end is due to the fact that at great distances stars must be of extraordinary lustre to be visible to the naked-eye, so that only a few of the naked-eye stars lie in these distant regions.

PLANET MT.—In addition to the Greenwich observations of this body on October 11th last, traces of it have been found on a plate taken at Heidelberg on October 17th. The following elements are rough, but give a general idea of the character of the orbit.

Perihelion Passage, 1911, August 31st.

Node	... ...	185° 27′
ω	... ...	151 27
i	... ...	8 32
Period	... ...	2·6 years
Eccentricity	... ...	0·40

Perihelion Distance, 1·15, practically the same as that of Eros.

The eccentricity is, however, much greater, and is almost the greatest known for planetary orbits.

BOTANY.

By PROFESSOR F. CAVERS, D.Sc., F.L.S.

POTASSIUM AND PHOTOSYNTHESIS.—At the conclusion of a paper on the photochemical synthesis of carbohydrates from carbon dioxide and hydrogen, Stoklasa and Zdobnicky (*Biochem. Zeitschr.*, Band 30, 1911) state that their experiments have given the following somewhat remarkable results. Neither formaldehyde nor carbohydrates are formed by action of ultra-violet light on water and carbon dioxide in absence of potash; but if potash be present, formaldehyde is produced, without formation of carbohydrates. By the action of ultra-violet rays on carbon dioxide and hydrogen, in presence of potash, neither formaldehyde nor carbohydrates are formed unless the hydrogen is in the nascent condition—in which case sugars are produced; without the action of these rays, carbon dioxide and nascent hydrogen produce, in presence of potash, formic acid but not carbohydrates. This is the first case observed of the synthesis of sugar from potassium bicarbonate and nascent hydrogen. The writers suggest that in the living green cells of plants the water and carbon dioxide, under the action of potassium bicarbonate, produce formaldehyde, which is then condensed into sugar in the presence of potash. The interest of these observations lies in the importance attached to potassium as an essential factor in the synthesis of carbohydrates from water and carbon dioxide in the living green cell.

LIFE CYCLE OF RED ALGAE.—The cytological observations of Yamanouchi on *Polysiphonia*, Lewis on *Griffithsia*, and Svedelius on *Delesseria*, suggest that not only in these genera but in all Red Algae in which the tetraspores and sexual organs are regularly borne in separate plants, there is an alternation of generations, the germinating carpospores giving rise to asexual plants, and the germinating tetraspores to sexual plants. Lewis has now (*Bot. Gaz.*, LIII.) succeeded in testing this matter by actual cultivation of the sporelings of a number of Red Algae, though it has proved a difficult task to raise the young plants. The physiological tolerance of these Red Alga sporelings is very small; temperature, light, and other factors may vary only within very narrow limits. The cultures had to be transferred to the open water, and many precautions taken to ensure their further growth.

Successful cultures showed that in *Polysiphonia* the carpospores produced only tetrasporic plants; while from the tetraspores of *Griffithsia* and *Dasya* only sexual plants were obtained. Tetraspores from a single individual produced male and female plants in approximately equal numbers in *Griffithsia*; the preponderance of males found in the cultures of *Dasya* is explained by the early development of the sexual organs on these as compared with the females. This segregation of the sexes in equal numbers agrees with what has been found in dioecious liverworts and other plants. Lewis obtained no evidence whatever that the double number of chromosomes in the carpospores imparts greater vigour of growth as compared with the single number in the tetraspores.

BIOLOGY OF SALT-MARSH PLANTS. — Two interesting papers have recently appeared which deal with the physiology of certain halophytic plants growing in salt marshes. Miss Delf (*Ann. Bot.*, XXV), describes experiments in which the loss of water by transpiration is estimated by measuring the total transpiring surface and observing loss of weight during withering. The author concludes that typical halophytes like *Salicornia* and *Suaeda* have a high rate of transpiration which is comparable with, or may be even greater than, that of a typical mesophyte like the broad bean. Statistics are given of the distribution and number of stomata per square centimetre in various salt-marsh plants. The stomata of *Salicornia* and *Aster tripolium* are not sunken nor protected by cuticle to any great extent, but rather resemble those of a typical mesophyte in being superficially placed, capable of opening and closing, and sensitive to light and to changes in humidity of the air. The stomata of *Salicornia* seem to lose power of movement after the flowering period, and then remain permanently closed; those of *Aster tripolium* were seen to open in air nearly saturated with water vapour, but closed in air with seventy-five per cent. humidity; those of *Suaeda* and *Atriplex* were never seen open at all.

Miss Halket (*New Phytologist*, X) describes experiments made with the object of ascertaining whether or not salt-marsh plants with high osmotic pressures can obtain water from atmospheric moisture and from sea-water. It was found that these plants can absorb water even when immersed in salt solution, whereas non-halophytic plants like the primrose decrease in weight when immersed in salt solution, though they increase when immersed in distilled water. The root-system of these salt-marsh plants is small in proportion to their size, hence the amount of water absorbed by the root is probably relatively small; the water obtained from atmospheric moisture through absorption by the aerial parts may compensate the plant for this smallness of root absorption.

BIOLOGY OF *SELAGINELLA*.—In a previous note in these columns ("KNOWLEDGE," 1911, page 350), some of the results of recent work on the reproduction of *Selaginella* was summarised. Seyd (*Inaug.-Diss.*, University of Jena) has published an interesting account of his observations on the biology of the vegetative organs of this well-known type. He has made experiments on the taking-up of water by the leaves, which had already been noted by previous writers but not fully investigated by them. He believes the ligule of the leaf is largely concerned in this absorption of water, and has made some ingenious and interesting experiments on this point. He placed shoots of *Selaginella* in solutions of various chemical substances and dyes, and the results in every case showed that the absorption occurred at the ligules of the leaves, and diffuses thence into the vascular bundles. Previous writers had suggested that the chief or sole function of the characteristic ligule of this genus is to protect the growing-point of the shoot and the young leaves. Seyd also experimented with the rhizophore and found that this organ absorbs water and salts only when it has reached the soil and produced root-hairs.

NAKED-EYE ANATOMY OF PLANTS.—Teachers and students of Botany are so accustomed to rely upon the compound microscope that they probably do not realise what a large amount of plant structure can be made out with the unaided eye or with a low-power pocket-lens. A useful and interesting paper by Arcichovskij (*Bull. jard. imp. bot. St. Petersbourg*, XII, 1)—unfortunately in Russian, but with a summary in German—contains an account of various materials, some well-known and others new, suitable for this purpose. The stems of cucumber and vegetable marrow, as is known to most teachers, have unusually large and distinct vessels in the wood, as well as large cells, and form an unrivalled introduction to the microscopic study of the tissues of plants. Almost equally suitable are the stems of balsam and begonia, while large cells (sometimes over a millimetre long) are to be seen in the flesh of the arbutus fruit, the epidermis of unripe tomatoes, and the epidermis of the leaves in various plants—*e.g.*, *Tradescantia*, begonia seedlings. Very large cells also occur in the leaves of various succulent plants, such as *Echeveria*, *Mesembryanthemum*, *Kleinia*, *Crassula*, *Aloe*. The nucleus can be plainly seen with a lens magnifying ten diameters, in the flesh of the arbutus fruit, and the streaming of the protoplasm in the enormously elongated cells of the stonewort *Nitella* is equally easy to see with a low-power lens or even with the unaided eye. The same simple method suffices for making out the distribution of the stomata in the leaves of the spruce fir and of various succulents—*Agave*, *Kleinia*, many cacti, and so on.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (OXON.), F.I.C.

DEVITRIFICATION OF SILICA GLASS.—Sir William Crookes describes in *The Proceedings of the Royal Society* (1912, LXXXVI, A, 406) a curious experiment upon a tube of silica glass. When this was exhausted and heated for several hours at a temperature of 1300° C. its structure was completely altered, and it had become devitrified to such a degree that it had become permeated to the extent of about eight per cent. with air. On repeating the exhaustion and heating the infiltration of air was found to have attained 46·6 per cent. of the capacity of the material, while in the case of a similar tube of ordinary glass only a minute bubble of air had entered.

Examined under the microscope the devitrified silica showed that the surface was broken up into cells, some of which were hexagonal. The effect closely resembled that produced by evaporating a solution of radium bromide in a silica dish, though when no heat is applied radium salts can be kept for many years in either silica or glass vessels. The devitrification of silica is thus caused either by exposure to a very high temperature or by the action of salts of radium at the temperature of boiling water.

ALCOHOL AND YEAST FROM BANANA MEAL.—A cheap process of manufacturing alcohol is described by Herr C. Nagel (*Zeit. Spiritusind.*, 1912, XXXV, 185), banana meal being used as the original material. The fruit, which must be unripe, since otherwise it forms a sticky mass when dry, is peeled, dried and ground to a meal. The meal is mixed with water and a little malt extract, and mashed at a temperature of 140° to 160° F. so as to effect the saccharification of the starch. This is brought about by the action of a diastase which is present in the banana, and to which the change of starch into sugar during the ripening of the fruit is due.

After completion of the mashing process the wash is cooled and set with a suitable yeast, which ferments the sugar into alcohol, a yield of 42 to 47·8 litres being obtained from one hundred kilogrammes of the meal, the cost of which is about sixty shillings.

The addition of the malt extract to the mash was found necessary for obtaining a good yield of alcohol, the quantities being much lower when the malt was omitted.

A wash obtained from a mixture of banana meal and malt, in the proportions of two to one, is an excellent medium for the cultivation of yeast of excellent quality, the yield amounting to about a fifth of the weight of the original materials.

ALLOYS OF RADIUM.—Messrs. de Mare and Jacobs describe the production and properties of an alloy of radium and silver in a communication to a Belgian journal, which is abstracted in the *Chem. Zentralbl.* (1912, I, 1430). The new alloy, which was obtained by reducing a mixture of silver chloride and radium sulphate by means of calcium carbonate and charcoal in a gas furnace, was a yellowish radio-active substance, which was sufficiently tenacious to be drawn out into a thin wire.

A deposit, possibly of the nature of an alloy, was also found to be formed upon the cathode, when a solution of radium acetate was electrolysed with platinum electrodes. The deposit was a brown substance, which was very radio-active.

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In connection with these investigations it was discovered that the light rays emitted by salts of radium could be transmitted through quartz plates of a certain thickness, while the α, β and γ rays were absorbed.

GEOLOGY.

By G. W. TYRRELL, A.R.C.Sc., F.G.S.

THE MINERALS OF TONOPAH, NEVADA.—A paper with this title is issued as Number 1 of the seventh volume of the Bulletin of the Department of Geology, University of California, and is written by A. S. Eakle. The Tonopah minerals occur in the great silver deposits of that district, and were previously mentioned by Spurr in his monograph on the Tonopah mining district. The typical ore consists of a gangue of massive white quartz and felspar, with blotches and bands of granular, black, silver minerals, pyrites, chalcopyrite, galena, blende, and occasionally flakes of free gold. It is deposited in an igneous rock, first designated by Spurr as "earlier andesite," but now recognised as trachyte. The Tonopah ore occurs in an arid region, in which simple hydration is not the dominant mode of weathering. What surface waters there are work downwards over the veins, strongly charged with soluble material from the overlying and adjacent rocks, and complex oxidations with unusual mineral precipitations result. The most important minerals in the zone of oxidation are the three silver haloids, cerargyrite, embolite and iodyrite, but numerous other rare minerals are obtained.

THE VOLCANOES OF MADAGASCAR.—Professor A. Lacroix, now the only one remaining of the brilliant trio of French petrologists, the other two members of which were Michel-Lévy and Fouqué, writes on the volcanoes of the French colonies in the Indian Ocean, especially those of Madagascar, in an address to the Congrès des Sociétés Savantes à Paris (April, 1912). Madagascar contains many volcanoes, both ancient and comparatively recent. The island is built up of a mountainous backbone consisting of crystalline schists and granite, rising abruptly out of a sandy plain on the east coast, and from under extensive stratified formations on the west.

Volcanic rocks abound in the midst of the sedimentary series. The principal centre is at Ankaratra near the centre of the island. The lavas of Ankaratra can be followed without interruption for over one hundred kilometres from North to South, and fifty kilometres from East to West. The total area covered by the volcanic rocks is certainly not less than four thousand square kilometres. It is believed that these belong to the Tertiary period, but in the absence of intercalated sediments and fossils it is impossible to date them exactly. Scoria cones and craters, still intact, show that the volcanic activity persisted until a very late period.

Vulcanism began in the Ankaratra massif by a deluge of black lavas—felspathic basalts—which, to judge by the extent of their flows, must have been emitted in a state of great liquidity. These lavas were erupted from a long series of volcanoes aligned in a N.N.E.–S.S.W. direction. After this outburst, the centres of activity became more localised and differentiated. In the centre and south of the massif, mica-trachytes were erupted, and in the south-west, alkali-trachytes and phonolites. After this extravasation of pale-coloured rocks a series of black nephelinites were erupted, descending in all directions from the high summits of the chain. The phonolitic rocks of the south-west are remarkable for the fine dome-topography they present. The same topography is found in a second, but smaller, massif, that of Itasy, to the north-east of Ankaratra. The phonolite domes or puys are here accompanied by very recent cones of basaltic scoria, and rest upon an undulating surface of ancient rocks, thus reproducing the essential features of the chain of puys in Auvergne. "Imagine," says Professor Lacroix, "the latter transported to the side of one of the Italian lakes, with its blue waters and azure sky, and you will have some idea of the marvellous panorama furnished by the Itasy region. If, however, the local colour is to be preserved, it would be necessary to people the lake with enormous crocodiles!"

METEOROLOGY.

By JOHN A. CURTIS, F.R.MET.SOC.

The weather of the week ended May 18th, as set out in the Weekly Weather Report issued by the Meteorological Office, was changeable. Rain was reported in all districts, thunderstorms were experienced on four days, and a sharp line squall passed over the Midlands on the 16th.

Temperature was above the average in all districts except Scotland, N. and W., and in Ireland. The highest readings were 74° in Jersey on the 12th, 73° at Tottenham and Camden Square on the 14th, and 72° at Greenwich and Southampton on the 12th. The lowest of the minima were 27° at Balmoral on the 13th, and 30° at Colmonell and Newton Rigg. Temperatures at or below the freezing point were reported from six districts. In the English Channel the lowest reading was 45°. On the ground the temperature fell to 23° at Balmoral and Newton Rigg and to 24° at Crathes. The soil temperature both at one foot and at four feet depths remained above the average of past years.

Rainfall was in excess in Scotland, N and E., and in England N.E., S.E. and the Midland Counties, but was in defect elsewhere. At a few places in Scotland and at Buxton the total precipitation for the week exceeded one inch, and at Wick it exceeded two inches, but generally the amounts were light. At Holyhead no rain was measured. Sunshine was above the average in most districts, markedly so in Scotland, E. and W., and in England, N.W. The sunniest district was Scotland, W. with a daily average of 9·4 hours (59%). The least sunny districts were the Midland Counties and England S.W., with an average of 5·9 hours a day (38%). The sunniest station was Douglas, Isle of Man, where the amounts registered equalled a daily average of 11·5 hours or 72 per cent. of its possible duration.

The mean temperature of the sea water round the coasts varied from 46°·0 at Berwick to 55°·9 at Eastbourne.

The weather of the week ended May 25th was generally cool, cloudy and unsettled. About the middle of the week thunderstorms were reported in the midland and eastern counties.

The mean temperature was above the average in England, E. and the English Channel, but below it elsewhere. The greatest deficiency was in Scotland, E., where the average value was only 46°·3 as compared with the average over twenty-five years of 49°·6. The maxima were low. In only four cases were temperatures of 70° or upwards reported, namely 72° at Greenwich, and 71° at Camden Square and in Jersey and 70° at Raunds. In most cases these occurred on the 19th. At all other stations the maximum for the week was less than 70°, and in Scotland, W., and England, N.W., the highest readings did not exceed 64°. The lowest readings for the week were 28° at Balmoral and 29° at West Linton and Markree Castle. In the English Channel the minimum did not fall below 46°. On the grass low readings were again reported, down to 22° at West Linton, and 24° at Crathes and Newton Rigg.

The temperature of the ground at one foot depth was generally below the average but at four feet depth it was still in excess. Rainfall varied greatly. In England, N.E. and the Midland Counties it was very heavy, at some stations four times as much as usual. In Scotland, on the other hand, the week was dry and in Scotland, N. the total was less than a quarter of the average amount. At Spurn Head, which is usually one of the stations with least rainfall, the total for this week was 2·07 inches as compared with an average of 0·36 inches.

Sunshine was in defect in all districts except Scotland, N., and the English Channel. The last-named district had the largest daily average amount, 9·6 hours (62%), but Scotland, N. reported 8·1 hours (48%), while the Midland Counties had only 4·2 hours (26%). The station reporting the greatest duration of sunshine was Deerness, Orkney, 11·2 hours (65%). At Westminster the average for the week was 4·9 hours (31%).

The mean sea temperature ranged from 46°·8 at Berwick to 56°·6 at Margate.

The week ended June 1st was fine and dry at first, but the weather became showery and thunderstorms occurred. Solar haloes were observed on the 26th. Temperature was below the normal generally, but in Scotland, W., and the English Channel it was slightly in excess. The highest readings reported were 77° at Greenwich and Camden Square on the 30th, with 74° at Norwich, and 73° at Raunds. The lowest of the minima were 29° at Llangammarch Wells on the 26th, 30° at Balmoral on the 27th, 31° at West Linton, and 32° at Colmonell on the 26th. At no other station besides the four just named was frost recorded in the air at four feet above ground. On the grass the lowest readings were 24° at Greenwich and West Linton, and 25° at Crathes. The temperature of the soil at one foot depth was below the average in most places, while at four feet depth it was still in excess.

Rainfall was more than usual in England, N.E., the Midlands and the English Channel. In England, S.E., it was just normal, but in all other districts it was in defect. In Scotland, E., the total was less than one quarter of the usual amount, and in Scotland, N., just over one-third. The number of rain-days over the whole kingdom agreed with the average.

Sunshine was above the average in England, S.E., N.W., S.W., Ireland, S., and the English Channel; it was equal to the average in Ireland, N., but below the average elsewhere. In England, N.E., the mean daily amount was only 3·8 hours (23%). In the English Channel it was 10·4 hours (66%). Of individual stations Baltasound, Shetland, reported a daily average of 1·4 hours (8%) while Weymouth had 11·6 hours (73%). At Westminster the average was 7·2 hours (45%), while Hampstead had 8·1 hours (51%). The temperature of the sea water ranged from 46° at Lamlash to 59° at Eastbourne.

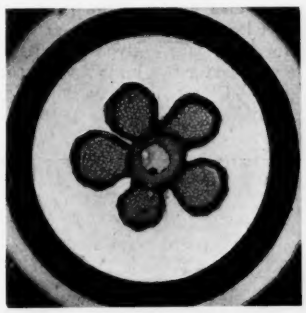
The weather of the week ended June 8th was very unsettled with much rain and many thunderstorms. Temperature was low for the time of year, every district reporting values below the normal. The maxima were unusually low. At only four stations were readings of 70° or upwards recorded, namely at Camden Square and Plymouth 71°, and at Greenwich and Tottenham 70°; these all occurred on the 6th. The lowest readings, however, were not as low as in the previous week, the minimum being 32° at Balmoral. The next lowest was 33° at Killarney. In Scotland, N. and E., with the exceptions of 32° at Balmoral already mentioned and 39° at Strathpeffer the minimum nowhere fell below 40°. At Leith and at Guernsey the lowest readings were the same, 48°. On the grass the lowest readings observed were 29° at Balmoral and 31° at Greenwich. The temperature of the soil, both at one foot and at four feet depths was below the average very generally.

Rainfall was slightly below the average in Scotland N., but was in excess in all other districts, and very greatly so in some. Thus in the English Channel the total for the week was 2·15 inches as compared with an average of 0·44 inches, or almost five times as much as usual. In Jersey it rained each day throughout the week, the total collected being 2·85 inches. At Harrogate the total was 3·20 inches, though at that station there were two days on which no rain fell.

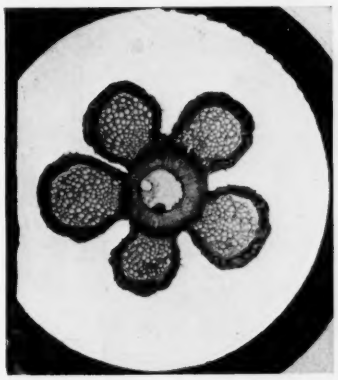
Sunshine was in defect in all districts, and at each individual station except Valencia and Markree Castle. Valencia was the sunniest station with a daily average of 7·6 hours (47%). At Glasgow the daily mean was only 0·9 hours (5%). In Westminster the daily average was 5·2 hours (32%).

The temperature of the sea water ranged from 47° at Berwick to 62° at Margate.

THE SPRING.—The period of thirteen weeks, March 3rd to June 1st, which is regarded from a meteorological point of view as Spring, was this year on the whole warm and dry, with an average amount of sunshine. In England, S.E., of the thirteen weeks seven were unusually warm, one unusually cold and five not far from average; two weeks were very wet, five weeks very dry and in six weeks the rainfall was about normal; while six weeks were unusually sunny, three weeks unusually dull, and during four weeks the sunshine was moderate.



A



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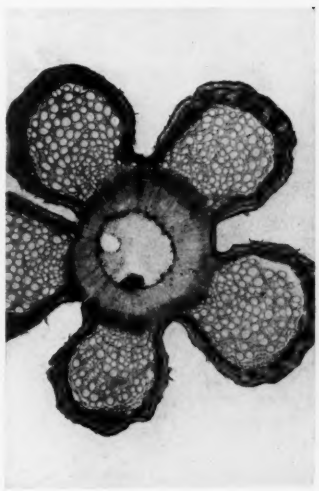

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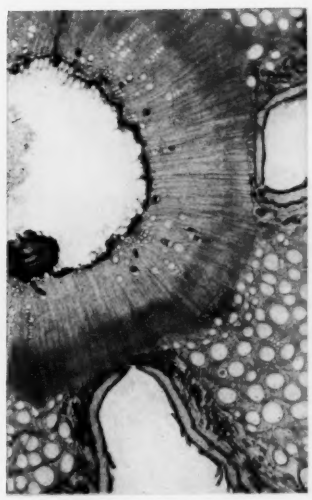

D

FIGURE 302. Trans-section of a Brazilian liana.

MICROSCOPY.

By F.R.M.S.

LOW POWER PHOTO-MICROGRAPHY. EQUIVALENT EXPOSURES.—One of the great troubles of the inexperienced worker in this fascinating branch of work is the problem of *equivalent exposures* with different lenses and stops, and so on. But I think the matter may be put in such a simple form that not only can it be easily understood, but what is perhaps of still greater practical importance—easily remembered and carried out in practice.

First, let us take the case of a fixed camera, length say twelve inches (objective to plate), and the same numerical stop number, *e.g.*, *f*.11.

I have four lenses whose focal lengths are four, three, two and four-fifth inches respectively. What are the equivalent exposures for the same object, lighting, camera length and stop?

Theoretically it may not be quite correct to say that exposure varies directly as area magnification or the square of linear magnification, but in practice this rule works quite well,

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as may be seen from the four examples here given. Photographers are in the habit of saying that the linear size of the image is proportional to the focal length of the lens. But this is not the case, and if we measure corresponding dimensions of A and B, taken with the four and three inch lenses respectively, we find that the longer focal length has given us the smaller picture. Moreover, their linear dimensions are not in the proportion of four to three. The fact is, firstly, that here normal conditions of everyday photography are changed and we are now using the longer conjugate distance. And this does not vary simply in proportion to focal length. Nevertheless, the rule is simplicity itself. If we call c the major conjugate, f the focal length of the lens and m the magnification, the formula is $c = (1+m)f$.

To apply this we subtract f from c and then divide what is left over by f. For example: with twelve-inch camera and four-inch lens. Subtracting four from twelve gives eight, and dividing this by four gives us two magnifications. In the case of the three-inch lens, taking three from twelve leaves nine, which divided by three gives three magnifications. Now area varies as the square of linear size and exposure varies as area size.

Putting matters in tabular form we see the whole thing at a glance.

	A.	B.	C.	D.
Focal length of lens	4″	3″	2″	¼″
Magnification (linear)	2	3	5	14
Area	4	9	25	196
Exposure	4″	9″	25″	3¼′

Examples A, B, C, and D (see Figure 302) were made with quarter plates cut in half, exposed as in the above table, developed, and printed together.

Now comes the everyday question of equivalent exposures with different lenses, camera lengths, and stops, but the same object and lighting conditions. For example: — (i) Camera length, fifteen inches; lens three-inch focus; stop, f.11. (ii) Camera length, sixteen inches; lens, two-inch focus; stop, f.16.

Ascertaining magnification in the way just mentioned, we get four and seven respectively. Area ratios are, therefore, as sixteen to forty-nine. With the same f value of stop in both cases, this would also be the exposure ratio. But we propose using f.11 in the first case, and f.16 in the second, so our exposure ratio becomes sixteen to twice forty-nine, *i.e.*, ninety-eight, or, say, one to six nearly.

By putting matters in tabular form, the arithmetic steps can be seen at a glance:—

Camera length	15-in. ...	16-in.
Focal length of lens	3-in. ...	2-in.
Magnification (linear)	4 ...	7
Relative areas	16 ...	49
Relative exposure with f. 11 in both cases	16 ...	49
Exposures with different stops ...	16 (f. 11)...	98 (f. 16)
Approximate ratio	1 ...	6

The object is a Brazilian liana, trans-section. Plates—Imperial N.F. Daylight reflected by substage mirror.

It is important to note that in the first table the exposures, measured in seconds, happened to coincide with the exposure ratio numbers. But this is merely a coincidence in this special case, where the nature of the subject and lighting conditions suggested four seconds for the first, and so the other exposure times necessarily agreed with the ratio numbers.

FIGURE 303. A Mesentery of the Frog.

Note the deeply-stained intercellular substance between the cells of the pavement epithelium covering one surface of the mesentery. (Photographed under Bausch and Lomb ⅛ objective, No. 10 ordinary ocular Bellows, length 7 inches).

Turning to the second table we see the ratio numbers are roughly one and six, but whether the exposures be one and six seconds or one and six minutes, and so on, will depend on the nature of the object that is being dealt with, speed of plate and lighting. I want to emphasize the point that the above considerations only give us *relative* and not actual times.

The practical application of the matter is this. By a few trials one can ascertain the exposure of, say, object P, under a given set of conditions, as in example (i) in the second table; but we want to deal with object Q under conditions (ii). We have ascertained for the *same* object that the exposure ratios are as one to six. If now we view the two different objects under the microscope, or as a ground glass image under precisely identical conditions, we can make a reasonably good guess as to their required exposures. Let us say, by way of example, that P seems to require about one and a half times that for Q, under precisely identical conditions, *i.e.*, P to Q as one and a half to one, or three to two. But the table for different conditions (i) to (ii) says one to six. Therefore, P under conditions (i), and Q under conditions (ii) combines these ratios; which we get by multiplying three and one and then two and six, or three to twelve, or one to four. Knowing the appropriate exposure of one of our objects the other is at once estimated.

F. C. LAMBERT.

AN ALTERNATIVE SILVER METHOD FOR DEMONSTRATING THE CEMENT SUBSTANCE IN PAVEMENT EPITHELIUM. — The usual method for staining the cement substance of epithelium consists in soaking the tissue in silver nitrate and exposing to sunlight until the tissue turns brown.

This method has a drawback in that it is dependent upon a fine day for a successful result. The method given below overcomes this disadvantage by doing without the exposure to light altogether.

A frog's mesentery may be taken as a typical example upon which to work. The method is as follows:—

1. Pin out the mesentery, with its encircling loop of intestine, upon a cork; then wash it once in distilled water.
2. Place the cork with the tissue undermost, in a half to one per cent. solution of silver nitrate for five minutes.
3. Wash in distilled water to rid the tissue of excess of nitrate.
4. Prepare a hydrokinone developer of the usual photographic strength, and dilute it with five times its bulk of water. In this immerse the tissue and cork, taking care to keep the tissue evenly covered with the fluid all the time. When the tissue has changed from white to a light grey, or light brown, remove it and wash very thoroughly to clear it of developer.
5. Next place the tissue in a five per cent. solution of hyposulphite of soda for fifteen to twenty minutes. Before starting Part 5 the tissue may be removed from the cork.
6. Wash thoroughly; place in a dish of water and cut away the intestine which encircles the mesentery. Dehydrate the latter in alcohol, clear in clove oil, and mount in Canada balsam.

It will be noticed that the method is divided into six parts. I find that the chief factor in obtaining a good result by this method consists in paying careful attention to Part 4. It is essential that the tissue should not be over-developed.

No light is necessary; on the other hand, a dark room is not needed, for the whole operation can be carried out on the laboratory table, either in the daylight or by artificial light.

Tissues prepared in this way are stained in black and white, thus providing a good contrast.

The accompanying photograph gives a good idea of the result obtained by this method.

C. E. JENKINS,
Physiological Laboratory, University College, Cardiff.

A DOUBLE DEMONSTRATING EYEPIECE. — This eyepiece, which has been introduced by Mr. E. Leitz, enables two observers to view jointly an object under the microscope. It slips into the draw-tube of the microscope like an ordinary eyepiece. The field of view is common to both eyepieces and contains a pointer which either observer can direct upon any feature to which he wishes to draw attention.

The arrangement of the device is shown in Figure 304.

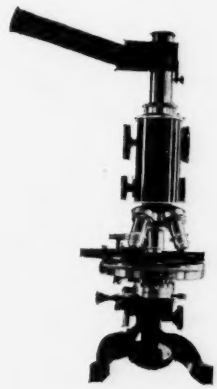

FIGURE 304.

The Double-demonstrating Eyepiece in position.

I and II are two prisms in contact and mounted above the diaphragm between the field lens and the eye lens of the eyepiece. The prism I has an isosceles cross section and its angles are 35°, 35°, and 110° respectively. The prism II is rectangular, and its angles are 35°, 55°, and 90°. The prisms are placed with those faces in contact which subtend the angles of 90° and 110° in such a manner as to leave between them a very thin film of air. This film is inclined at an angle of 30° to the axis of the eyepiece and partially reflects the emerging pencil of rays; about two-thirds of the rays pass through the prisms, and one third is reflected.

The image formed along the axis of the microscope is accordingly brighter than that produced by partial reflection. The centre line of the reflected pencil is inclined at an angle of 70° to the axis of the microscope. III is the prism, the lower surface of which reflects the pencil upwards at a convenient angle for observation. In order that the two observers may not be in each other's way the branch tube is fitted with a system of lenses which resembles a terrestrial eyepiece. The image as seen in the side tube is reversed with respect to that which appears in the axial eyepiece; but this would hardly affect the observer, especially since the oblique attachment of the side eyepiece already introduces unusual conditions of working.

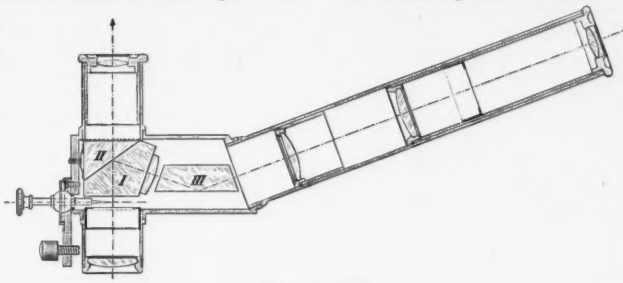

FIGURE 305.

Details of the Double-demonstrating Eyepiece.

As a matter of fact, the more expedient course is to adjust and focus the object through the principal eyepiece, as the image seen through it is brighter and easier to focus. The adjustment for one eyepiece furnishes also a clearly-defined image in the subsidiary eyepiece, provided the eyes of both observers can accommodate in a similar manner. The objective in conjunction with the field lens below the double prisms of the two eyepieces forms an image in the plane of the diaphragm below the double prism. This image and the pointer, being both in the plane of the diaphragm, are seen simultaneously in the principal and the subsidiary eyepieces.

The pointer can be moved backwards and forwards and turns on a pivot, so that its extreme end can be set at any point in the field. The Double Demonstrating Eyepiece is made in two powers, one having a magnification of four diameters, and the other of six diameters. In both cases the resulting images are sharp, colourless, and free from distortion. The fact that the image seen in the subsidiary eyepiece is fainter than the other is no serious drawback, as the eyepieces are solely intended for demonstrating purposes, and the demonstrator's acquaintance with the object will generally enable him to see every detail clearly under these less perfect conditions. When diffused daylight does not suffice to bring out fine details distinctly in the darker portions of the field, it will be necessary to use one of the artificial illuminators which are generally to be found in laboratories such as electric glow-lamps, arc lamps, Welsbach or acetylene lamps. With high power objectives it is generally advisable to set the draw tube of the microscope about one centimetre shorter than its standard length.

The double demonstrating eyepiece is also well adapted for the instantaneous photography of living bacteria, and other moving organisms illuminated by means of a dark ground condenser. It enables one to watch the object through the side eyepiece, and to defer the exposure until a favourable moment presents itself.

THE ROYAL MICROSCOPICAL SOCIETY — PRESENTATION TO MR. FREDERICK A. PARSONS.—A very pleasing little ceremony took place at the meeting of the Royal Microscopical Society on June 19th. The President, Mr. H. G. Plimmer, F.R.S., presented to Mr. Frederick A. Parsons (on his retirement from the office of Assistant Secretary after sixteen years service) with an illuminated address and a cheque, on behalf of the Fellows of the Society. Mr. Plimmer further mentioned that the Council had reinstated Mr. Parsons as a Fellow of the Society, and had passed a resolution that all annual contributions in the future should be remitted. This announcement was received with great applause, and Mr. Parsons was evidently much pleased with the recognition that had been made of his efforts.

QUEKETT MICROSCOPICAL CLUB.— May 28th. — Mr. E. M. Nelson, F.R.M.S., wrote that he had examined a mount, supplied by Mr. H. F. Angus, of Mr. Siddall's diatoms, showing the so-called pseudopodia (see "KNOWLEDGE," May, 1912, page 193). Using a $\frac{1}{12}$-in. Leitz apochromat, structure like a spiral filament in a tube was observed. This was in a *Coscinodiscus*. In a *Biddulphia* the structure resembled aminutely-jointed antenna.

Mr. R. T. Lewis. F.R.M.S., read "A note on *Solpuga (ferox?)*" This genus is included in the fifth order of the Arachnida. About fifty species are known, all African. In length the adults measure from one to two inches and vary in colour from reddish-brown to dull grey. They are covered with hairs of several distinct kinds. They are armed with two pairs of enormously developed chelicerae placed near together side by side and opening vertically. Two large simple eyes are present. The cephalothorax is formed of six segments, the first three fused. Spinning organs are absent. No poison-sac or duct has been found. On the dorsal surface near the extremity of each of the chelicerae in the male, there is a curious organ, the flagellum, the function of which is unknown. Of the five pairs of lateral appendages the first are the pedipalpi, six-jointed. The first, second and third pairs of legs are also six-jointed. The fourth pair is very

remarkable, being eight-jointed, exclusive of the division of the tarsus which has one long and six short joints in addition to the claws. These, like those of the second and third pairs are also jointed near the ends. Three out of the four joints nearest the body have five curious fan-shaped organs suspended from them by flexible stems which connect them with the tracheal and nervous systems. These are the malleoli, and measure about 1·7 millimetres across in the widest part. The convex lower edge of each fan is bordered with fine vertical striae about 2·5 μ apart. We have no knowledge as to the functional use of these appendages. Preparations and micro slides of *Solpuga* were exhibited in illustration of the paper.

Mr. A. E. Conrady, F.R.M.S., made "Some remarks on experiments on alternative microscopical theories."

ORNITHOLOGY.

By HUGH BOYD WATT, M.B.O.U.

WHITE STORK (*CICONIA ALBA*) NESTING IN CAPTIVITY.—Hitherto, the only records we have of this bird rearing its young in captivity in this country are from Kew Gardens in the years 1902 and 1903. In the Zoölogical Gardens, London, last year (1911) four eggs were laid and one bird hatched out, which did not survive. This year five eggs were laid and they have all been hatched out and, it is hoped, that some, at any rate, of the young may be successfully reared.

THE BRITISH BLACK-BACKED GULL.—Dr. Percy R. Lowe has separated the *Larus fuscus* of Linnaeus into two races, which he proposes to name *Larus fuscus fuscus* and *L. fuscus britannicus*. The last named is a new subspecies and, according to Dr. Lowe, sufficiently distinguished as a more western or light-backed race from the Scandinavian or more eastern, dark-backed form, to justify the opinion he has arrived at (*British Birds*, June 1912, Vol. IV, pages 2–7, with a plate).

THE BREEDING RANGE OF THE FULMAR IN THE BRITISH ISLES.—In the last two numbers of the *Scottish Naturalist* (May and June, 1912, pages 97–102 and 121–132) Dr. J. A. Harvie-Brown gives a detailed and informative account of the extension in recent years of the breeding quarters of the Fulmar (*Fulmarus glacialis*) on our northern coasts. The species has been long known as nesting in great numbers on St. Kilda, there being continuous historical evidence of this extending back for some two hundred and fifty years. A remarkable feature of this station was its isolation, none other being found nearer than Iceland and Spitzbergen, until the year 1838, when a settlement was made on the Faroes. On St. Kilda the numbers of the birds have considerably increased, but Dr. Harvie-Brown leaves it open to question whether those now nesting at other places came from St. Kilda or from more northern regions, or from both; and he also leaves for future discussion the probable cause or causes of the widespread colonisation which has taken place. In chronological order that process may be summarised as follows:—In 1878 Foula was occupied: in 1886–7, North Rona and Sulisgeir; in 1889, Stack; from 1891 onwards, various places in Shetland, nearly twenty being now frequented in this group of islands; in 1897, near Cape Wrath and in 1900–1 Dunnet Head (both on the Scottish mainland); from 1900 onwards, several places in Orkney; in 1902, Fair Isle, Flannan Islands, Handa, and Barra Head; in 1910, Shiant Islands; in 1911, Berriedale Head (Caithness) and in the same year Ireland was reached and Ulster and Mayo populated. Of the localities named only Ireland and Barra Head are south of St. Kilda, and all the places are smallish islands except the two in Ireland and three in Scotland.

It is interesting to recall that Darwin, in "The Origin of Species," says that the Fulmar is the most numerous bird in the world, but the grounds or authority for the estimate are not given.

PHOTOGRAPHY.

By EDGAR SENIOR.

REVERSAL OF THE PHOTOGRAPHIC IMAGE.—In order to obtain a perfect negative of the subject being photographed, it is necessary that the exposure should be as correct as possible, over-exposure resulting in a flat and often very foggy image, while when still further prolonged "to a sufficient extent," causing a reversal of the first effect of the light action. Reversal, then, in its most complete form results in the formation of a positive, instead of a negative image upon development, or while the greater portion of the image may be negative, the rest will be positive, owing to the great difference in brilliancy between the objects photographed. An example of this kind is seen when including the image of the sun in a landscape, an exposure sufficient to bring out detail in the near foreground producing a reversal of the sun's disc. The cause of this phenomena can scarcely be considered as thoroughly established, owing chiefly to the uncertainty which exists as to the nature of the alteration brought about when light changes silver bromide in a gelatine plate into a developable condition. Experiment, however, has shown that the image, "as far as development is concerned," can be destroyed by quite a number of agents. Almost anything that will readily part with oxygen will do it; hence such substances as permanganate of potash, potassium bichromate, any of the ferric salts, ozone, peroxide of hydrogen are effective. There is still one other substance which has a destructive action upon exposed silver bromide and that is bromine. If a plate that has been exposed to light is treated with bromine water, the image will be destroyed. Its presence during exposure is accounted for on the hypothesis that it is liberated by the light's action, although it is an open question whether any halogen is set free during a normal exposure. There appears little doubt, however, that something of this nature does occur during a very prolonged one, and it only remains as to the length of time that must elapse before this change commences. In any case it has been shown that if a gelatine or other plate be soaked in a strong solution of sodium sulphite or potassium nitrite no reversal will occur during an unlimited exposure to light. These experiments therefore form strong evidence in favour of the argument that bromine in some way is the cause of the trouble. If the halogen acts in such a manner that it reconverts back to its original state the light-altered compound, its behaviour furnishes an example of reversible chemical action in which the products of the reaction will under certain conditions react with each other to re-form the original substance. As an example we may take the case of the preparation of hydrogen by the passing of steam over red-hot iron, when a reaction expressed by the equation $Fe_3 + 4\ H_2O = Fe_3O_4 + H_8$ occurs, but it is equally true that if Fe_3O_4 and hydrogen are heated together the reaction expressed by this equation occurs:—$Fe_3O_4 + H_8 = Fe_3 + 4\ H_2O$. Now under certain conditions either of these reactions may be carried to approximate completion, but if iron and steam be heated together in a closed vessel the iron will never be completely oxidised, because as soon as any Fe_3O_4 and H are formed they tend to react with each other to re-form H_2O and Fe, in other words the reaction is reversible, or can take place in either direction at the same time, and may be represented as follows:—

$$Fe + 4\ H_2O \rightleftarrows Fe_3O_4 + H_8$$

It has, however, been shown that under certain conditions the whole of the iron can be completely oxidized as expressed by the equation $Fe_3 + 4\ H_2O = Fe_3O_4 + H_8$, the conditions being that the hydrogen shall be removed from the sphere of action as fast as it is formed. In order to do this a large excess of steam over that shown in the equation is necessary, in order that the hydrogen may be swept away and so prevent it converting back to its original state some of the product of the first reaction. On the assumption then, that bromine is set free by the action of light we have an analogous case, in which the halogen will, unless removed, react with the altered silver salt, or it may be enter into com-

bination with the gelatine and indirectly give rise to the formation of bodies which have an equally deleterious action upon the developable image. It is now thirty years ago since Sir William Abney in one of a course of Cantor lectures

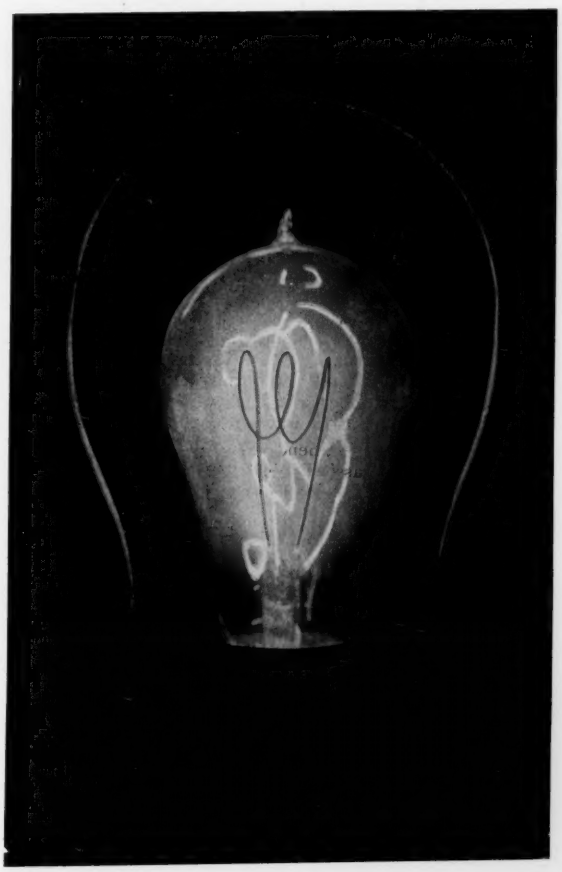

FIGURE 306.

(1882) delivered before the Society of Arts, dealt with this subject of reversal, showing a film which had received an exposure of one minute behind a negative to direct sunlight, and yet the image obtained was quite free from any effects of reversal. This was explained as being due to the film having been treated with potassium nitrite which took up the bromine as fast as it was formed, and so prevented it from attacking the silver bromide that had been altered by light. And to use this scientist's own words: if you want to get rid of reversal you must give the plate something which will very rapidly absorb bromine, and which if possible is not organic. What was foreshadowed as being possible so many years ago, has now been practically realized by the discovery that certain salts or derivatives of hydrazine possess the required properties, and plates coated with emulsion containing these bodies have been placed upon the market by the Paget Prize Plate Company Limited, under the name of "Hydra" plates. By the courtesy of the Paget Company the writer has been able to try these plates, with the most gratifying results—subjects from which, owing to their great difference in brilliancy, it had been impossible to obtain satisfactory results previously, photographed most perfectly, there being not the slightest trace of reversal, and the invisible backing with which the plates are coated preventing halation, even with very prolonged exposures. The examples which form the illustrations to this article will, I think, speak for themselves, Figure 306 being a photograph of an incandescent electric light, taken on an ordinary rapid gelatine plate, while Figure 307 is the same lamp photographed under the same conditions on a Paget "Hydra" plate. In Figure 306 the image of the filament is entirely reversed, while in Figure 307 there is no sign of reversal, beyond which the increased brilliancy (luminosity) given with the "Hydra" plate is quite evident as well. The speeds of the plates employed were 250 H. and D. and the exposures given were forty minutes with stop F 22 although we found that complete reversal was obtained on the ordinary plate in ten minutes. The developer employed in both cases was a normal pyro-soda one, used in everyday work, so that no departure was made from ordinary procedure. When the degree of over exposure is very great, "some forty-times," then a special developer has to be used. This, however, is supplied in a convenient form by the makers of the plates.

EXPOSURE TABLE FOR JULY.—The calculations are made with the actinograph for plates of speed 200 H. and D., the subject a near one, and lens aperture F.16.

Day of the Month.	Condition of the Light.	Time of Day.			
		10 a.m. and 2 p.m.	8 a.m. and 4 p.m.	6 a.m. & 6 p.m.	5 a.m. and 7 p.m.
July 1st	Bright	·09 sec.	·12 sec.	·2 sec.	·45 sec.
,, ,,	Dull	·18 ,,	·24 ,,	·4 ,,	·9 ,,
July 15th	Bright	·09 sec.	·13 sec.	·27 sec.	·52 sec.
,, ,,	Dull	·18 ,,	·26 ,,	·52 ,,	·97 ,,
July 30th	Bright	·09 sec.	·13 sec.	·3 sec.	·64 sec.
,, ,,	Dull	·18 ,,	·26 ,,	·6 ,,	1·27 ,,

Remarks.—If the subject be a general open landscape, take half the exposures given here.

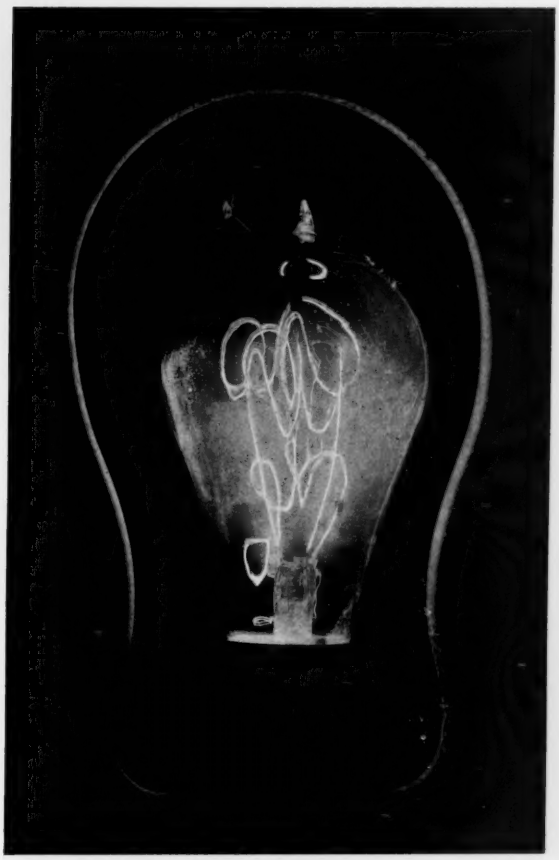

FIGURE 307.

AUTOCHROME SCREEN. — From Messrs. J. H. Dallmeyer, Ltd., of 25, Newman Street, Oxford Street, we have received an Autochrome screen in optical flats suitable for use with high-class anastigmats, telephoto, process and other lenses. These screens are made in diameters varying from one and a half inches to three inches and at prices from twenty-two shillings to fifty shillings. They are worked to an accuracy of a one-five-hundred-thousandth part of an inch.

We have examined this screen and consider that it fully bears out the claim made for it by the makers, and the high reputation enjoyed by Messrs. Dallmeyer should be sufficient guarantee of its excellence.

PHYSICS.

By ALFRED C. G. EGERTON, B.Sc.

SEMI-OILY LIQUIDS ON A WATER SURFACE.—When a drop of liquid is placed on a water surface the effect produced depends on the solubility of the liquid. An oil forms a permanent film; but a slightly soluble liquid forms a film which breaks up into globules. The globules are formed by indentations spreading rapidly into the films and causing partition. Sometimes the globules are projected violently across the surface of the water. Mr. C. R. Darling has made a careful study of these effects which he has brought to the notice of physicists: his last paper to the Physical Society on the subject was read on Friday, May 1st. He has investigated many organic liquids, among the most interesting being aniline, dimethylaniline, quinoline, and 1:3:4 xylidine. Aniline, after spreading into a film, collects into one or more large globules, which become indented round the edges and then recover their shape with partition of a few small globules. Dimethylaniline breaks up into small globules much more rapidly; the indentations spread and bifurcate very rapidly, dividing the film into globular portions.

Quinoline behaves very much like dimethylaniline, but works slower. The small globules formed in this case finally become rings which are quite permanent and distinctive of quinoline.

Xylidine and orthotoluidine form globules which become indented on one side and move rapidly across the surface usually away from the side where the indentation has occurred; the globules become reniform in shape. The globules thus gradually break up into smaller globules.

Mr. Darling's explanation of these interesting effects is the following:—The surface tension of the water is weakened by the solution of the liquid. The opposing tensions then overcome that of the water, with the result that the film is drawn back and indented. The strength of the air-water tension is then partially restored by the sinking or diffusing of the dissolved part so that the drawn-up mass again tends to spread. Indentations would therefore occur where the air-water tension had become most weakened; and if the opposing tensions were strong enough, the globule would be drawn across the surface of the water. Equilibrium would be established when the air-water tension had become uniformly weakened and the opposing tensions possessed a resultant tension equal to that of the soiled water.

It would be interesting to investigate the effects of films of liquids on solvents such as acetone, alcohol, and so on, instead of water; perhaps similar interesting phenomena would be obtained.

ZOÖLOGY.

By PROFESSOR J. ARTHUR THOMSON, M.A.

EGG-TOOTH OF BIRDS.—One is glad to hear something more in regard to the so-called egg-tooth of young birds, which is none the less interesting that it has nothing to do with teeth, being simply a horny knob. If it is of use in breaking through the egg-shell, which seems in some cases at least very doubtful, it is used only once. As everyone knows, it soon falls off. The fact suggests the question whether it may not be a derivative of some older structure with a different use; for this is a common thing in organic evolution, that the apparently new should arise from the very old. Some recent observations by B. Rosenstadt suggest that the egg-tooth of the upper jaw, and its corresponding vestige on the lower jaw, may be a relic of an ancient armature, older than the horny sheaths we are familiar with. In the first place, the egg-tooth above and the vestige below become horny before there is any other cornification on the jaws. In the second place, the process of making horn in the egg-tooth is different from that elsewhere. Each of the skin cells concerned turns wholly into horn-fibres, nucleus and all, whereas in ordinary cases, as in the horny covering of the jaws, only the mantle of each cell is turned into horn.

LOCOMOTION IN SNAILS.—When we watch a snail creeping on a pane of glass we see beautiful waves of contraction passing along the "sole of the foot," *i.e.*, the snail's muscular ventral surface. The foot works partly as a holdfast, adhering by its mucous secretion, or by acting like a sucker, or by both means. Professor G. H. Parker has studied numerous Gastropods and finds that the locomotion may be accomplished without (arhythmic) or with (rhythmic) the pedal waves. In rhythmic locomotion the waves may run from posterior to anterior (direct) or the reverse (retrograde), but a snail never moves backwards. The foot may show one, two, or four series of waves. When there are two series, the waves may be alternate or opposite.

"The pedal wave is an area of the foot that is lifted off the substrate as compared with the rest of the foot and thereby freed more or less from adhesion. It is also the region of the foot that moves forward, the rest of the foot remaining temporarily stationary. Locomotion is the cumulative result of local forward movement on the part of one section of the foot after another till the whole foot has been moved. The same type of muscular movement as that seen in rhythmic locomotion can be present in a diffuse form (not wave-like) in a gastropod foot and will result in locomotion."

EFFECT OF ALCOHOL ON GENERATIONS OF ROTIFERS.—Dr. D. D. Whitney studied four strains of parthenogenetic rotifers, originally descended from one female, for twenty-eight successive generations. One strain was kept as a control, the other three strains were kept in a quarter per cent., a half per cent., and one per cent. solution of alcohol. The rate of reproduction was lessened in the alcoholic strains. Those of the one per cent. alcoholic strain showed in the XI–XV generations a decidedly increased susceptibility to copper sulphate used as a test of resistance. When the alcohol was removed in generations XI–XXII, the rate of reproduction increased noticeably in the first generation, and in the second equalled that of the control. Individuals of the second generation after the alcohol had been removed were no more susceptible to copper sulphate than those which had never been alcoholised. The general conclusion is that the grand-children possess none of the defects caused by alcohol in the grand-parents. Alcohol in the percentages used affects only the body tissues. If the animals were subjected to it indefinitely, generation after generation, the race would probably become extinct because of its "lowered resistance power" to unfavourable conditions. "However, if the alcohol is removed it is possible for the race to recover and to regain its normal condition in two generations, thus showing that the germ substance is not permanently affected by the alcohol."

MEDUSOID OF MICROHYDRA.—One of the simplest of the freshwater polyps, which have doubtless evolved from a marine stock, is *Microhydra ryderi* Potts, reported some years ago from North America. It was known to liberate a minute Medusoid. In 1909, Professor Goette, of Strassburg, recorded its occurrence in Germany. In the warm summer of last year its medusoid stage—which has been carefully searched for—was found by W. Schorn, in Finow Canal, near Eberswald.

A KNOWLEDGE OF THE ORIGIN AND EARLY HISTORY OF THE ROYAL HORTICULTURAL SOCIETY AS DERIVED FROM CONTEMPORARY MEDALS, CARICATURES AND OTHER RARIORA.

By A. M. BROADLEY.

Author of "Dr. Johnson and Mrs. Thrale."

THE foundation of the Horticultural Society of London in the year before Trafalgar, and its incorporation by a Charter of Incorporation, granted by King George III in 1809, the year in which he celebrated his Jubilee, were the result of the steady progress made in garden-craft during the greater part of the eighteenth century. The successful Horticultural Exhibition of 1912, the greatest effort of the kind ever conceived and carried out either in England or on the Continent, may be regarded as commemorating the centenary of the powerful and progressive association which, ever since its first inception, has accomplished so much for the advancement of horticulture both in its scientific and practical aspects. It was towards the middle of the century in which Sir Joseph Banks [1743 - 1820], Daniel Charles Solander [1736 - 1782], Gilbert White [1720-1793] and Lancelot Brown [1715-1783] (see Figure 308) flourished, that the calling of the nurseryman and the florist attained the importance which is reflected in the ornate trade-cards and seed-lists issued by Henry Scott, of Weybridge, John and George Telford, of York (both of which are now reproduced in Figures 310 and 311) and many others. Outward and visible signs of the good work done by Lancelot Brown (better known by his more familiar sobriquet of "Capability"), the pioneer of English landscape-gardening (whose portrait is now given), are still abundant. Brown, like Banks, received much encouragement from the sovereign to whom posterity has given the name of "Farmer George," whose love of gardening was as great as his fondness for cattle-rearing. It was "Capability" Brown, the reviver of the natural style of landscape-gardening, who laid out the grounds of Kew and Blenheim, in addition to designing a great number of country houses. In 1770 Brown served the office of High Sheriff of Huntingdon. While superintending the works at Kew he is said to have spoken some plain truths to the King, which Sir Joseph Banks was possibly too much of a courtier to utter, although he also had a serious difference with His Majesty about the introduction into England of the merino sheep. The business founded by "Capability" Brown is still in existence, and it is certainly a notable coincidence that Mr. Edward White, to whose untiring efforts and spirit of enterprise much of the success of the recent great exhibition at Chelsea may be fairly attributed, is connected with it.

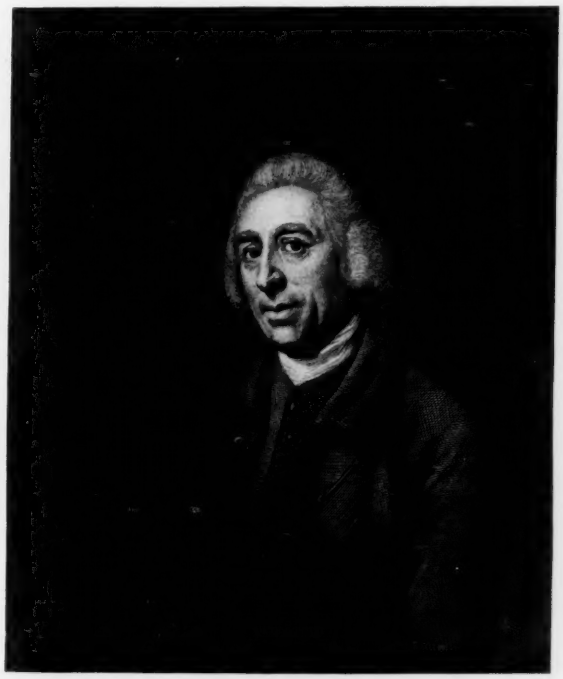

FIGURE 308.

Lancelot ("Capability") Brown, the father of English landscape-gardening, 1715-1783.

In the pages of Mr. Edward Smith's interesting and carefully-compiled "Life of Sir Joseph Banks," published last year by Mr. John Lane, we find a good deal of information concerning the foundation of the Royal Horticultural Society and the early enthusiasm for garden-craft of which its establishment was the outcome and practical result. The gardens of the genial President of the Royal Society, both at Spring Grove and Revesby Abbey, were equally wonderful. The total disappearance of the former, through "suburban encroachment," is to be sincerely regretted. The grounds of Revesby still retain much of the luxuriant beauty which the efforts of Sir Joseph Banks and his wife and sister imparted to them. We are indebted to Mr. Smith for a picture of Spring Grove as it appeared about the time the

XUM

Horticultural Society of London came into existence. It suggests both "a real adjacent grove and possibilities of a large and roomy garden." The pond from which

JAMES HAIR'S,
SEEDSMAN & FLORIST
at the Top of the Haymarket London
Sells
all sorts of Garden, Bird, & Grass Seeds,
also Durham Flower of Mustard.
(N B)
Choice of Green House Plants, Curious Exotics, &c

FIGURE 309.
A Trade Card of a Haymarket Florist in 1780.

Spring Grove derived its name was the scene of various experiments. One of these was the raising of the American Cranberry upon an artificial island, and the growing of *Zizania aquatica*, a singular grass used for food by the Indians in Canada, from seeds imported in 1791. It was, however, in the improvement of apples, peaches, grapes and figs that Sir Joseph was most successful. A great feature was also made of strawberry-growing at Spring Grove, where Banks successfully popularized the system of mulching with straw. Mr. Smith says:—"Many new importations of flowers are on record which were first planted in Spring Grove.

FIGURE 310.
Eighteenth Century Heading of the Seed Catalogue of John and George Telford of York.

Rosa banksiae was sent by William Kerr, from China to Kew, and also to Banks's garden, where it became a great favourite, and much attention was paid to its cultivation. Isaac Oldaker (Lady Banks's gardener) submitted it to the Royal Horticultural Society in 1820, remarking that "by care it had been transformed from an insignificant greenhouse plant into a hardy and splendid creeping shrub." The Paeony was another of the personal triumphs of Sir Joseph Banks. It was first cultivated at Kew, but in 1805, the Double Scented Paeony was added to the glories of Spring Grove. As early as 1789, Banks exhibited the Hydrangea to his friends in Soho Square. It has since become the parent of a numerous progeny. As might be expected the scientific efforts of Banks made him the target of literary and pictorial satire. He was not spared

FIGURE 311.
Eighteenth Century Trade Card of Henry Scott of Weybridge.

either by James Gillray or John Wolcot, both of whom shewed little mercy to George III. In the matter of horticulture, as in the graver concerns of politics, "the scoffer was abroad."

Daniel Charles Solander had been recommended to English naturalists by Linnaeus himself. In 1768, he accompanied Sir Joseph Banks on Cook's voyage in the "Endeavour," and four years later went with him to Iceland. Until he was made Keeper of Printed Books at the British Museum he acted as secretary and librarian to Banks in Soho Square. We have caricatures of both Banks and his fellow-worker, Solander, published about 1770 by Darby of the Strand. They were both represented as Macaroni

By the courtesy of Mr. John Lane.

FIGURE 312.
A Caricature of Solander.

exquisites. Banks is portrayed (see Figure 313) in the act of endeavouring to capture a splendidly-coloured butterfly with a bat-shaped fly-catcher. Below the design are the words:—

I rove from pole to pole. You ask me why.
I tell you truth, and catch a—fly.

The "Simpling Macaroni" is an etched whole-length portrait of Solander (see Figure 312), holding in one hand a large flowering plant, and in the other a naturalist's knife, on the blade of which is written the maker's name "Savigny," one of the well-known eighteenth-century makers of scientific instruments. Below we read:—

Like Soland Goose from frozen zone I wander
On shallow Banks grow fat Solander!

John Wolcot and Thomas Rowlandson joined forces to represent Sir Joseph Banks as a promoter of a "fly club" (see Figure 315), and John Gillray produced a remarkable cartoon in which he depicted the "Great South Sea Caterpillar, transformed into a Bath Butterfly" (see Figure 314).

Enter, Sir Joseph, gladdening Royal eyes.
What holds his hand? A box of Butterflies!
Grubs, nests, and eggs of humming-birds to please,
Newts, tadpoles, brains of beetles, stings of bees.

Wolcot devoted at least three odes to the ridicule of Banks, but they do not appear to have had any more serious effect on the successful grower of strawberries at Spring Grove, than fifty similar attacks by the same ruthless hand had on the King and Queen at Windsor, Weymouth and Kew. It was reported that the Royal Princesses were "vastly amused," and so possibly were Mrs. and Miss Banks.

To John Wedgwood, of Betley, in Staffordshire, must, according to Mr. George Smith, be credited the original idea from which the Royal Horticultural Society sprang. His identity has, curiously enough, often been confused with that of Josiah Wedgwood, the famous potter. John Wedgwood, of Betley, was an enthusiastic horticulturist and naturalist, and an intimate friend of Thomas Andrew Knight, who

By the courtesy of Mr. John Lane.

FIGURE 313.
A Caricature of Sir Joseph Banks.

By the courtesy of Mr. John Lane.

FIGURE 314.
Gillray's Cartoon of Sir Joseph Banks.

eventually became President of the newly-formed association, which certainly owed much of its early success to the inspiriting influence of Spring Grove. It was during the last decade of the eighteenth century that the example set by Banks was largely followed by his numerous friends and acquaintances, many of whom profited by his advice in improving their existing gardens and building new hot-houses. "One of these friends," Mr. George Smith informs us, "was Charles Greville, the philandering nephew of Sir William Hamilton, who had a fine garden at Paddington Green, and, in his latter years (having presumably sown his wild oats), proved a good horticulturist and successful importer of exotics." The success of Mrs. Joseph Marryat's garden at Wimbledon is said to have rivalled that achieved at Kew. It was on the afternoon of March 7th, 1804, when England was in the throes of the Great Terror, that John Wedgwood induced Charles Greville, Sir Joseph Banks, and

By the courtesy *of Mr. John Lane.*

FIGURE 315.

Rowlandson's—"A Feast at the Fly Club."

Messrs. Salisbury, Aiton, Forsyth, and Dickson to foregather in a room behind Mr. Hatchard's shop in Piccadilly. Mr. Smith does not give the name of Thomas Andrew Knight amongst those present, but in the paper read at Chester on August 4th, 1896, by Sir Trevor Lawrence, P.R.H.S., the project of founding the Royal Horticultural Society was wholly attributed to Thomas Andrew Knight, F.R.S., "a name associated with the Society during a long course of years, and ever regarded with the highest honour by all connected with it." "Mr. Knight," says Sir Trevor Lawrence, "had devoted much attention to scientific horticulture and vegetable physiology, on which subjects he had communicated several papers to the Royal Society. He lived in Herefordshire in the midst of a cyder and perry country, and had been struck by the unskilful and unscientific management of the surrounding orchards. He put himself into communication with Sir Joseph Banks, P.R.S., Mr. R. A. Salisbury, Messrs. Aiton and Forsyth, the royal gardeners and others, the result being that on March 7th, 1804, the new society was founded." The name of Mr. John Wedgwood does not even occur. Mr. Smith, on the other hand, declares him to have been at once the head and moving spirit of those who desired to found the London Horticultural Society, being "dissatisfied with the prevailing habit of leaving all to the gardener, who generally pursued the dull routine of his predecessor, without science and with little intelligence." Those who assembled on that eventful afternoon in the parlour of John Hatchard felt sure of being able "to improve almost every esculent plant or fruit by the adoption of system and foresight in gardening operations." Sir Trevor Lawrence makes T. A. Knight the suggestor of the Piccadilly gathering; Mr. George Smith, quite as distinctly, assigns that position to John Wedgwood.

The premises of John Hatchard have been lately rebuilt, and the façade overlooking Piccadilly is once again very much what it was in 1804 when Knight or Wedgwood, or both, called their friends together there to form the Horticultural Society of London. That Sir Joseph Banks was of the party there can be very little doubt. Nineteen years ago Mr. Arthur L.

FIGURE 316.

George Cruikshank's Celebrated Caricature of the Horticultural Society in 1825.

Humphreys, who is now the head of the house of Hatchard, told the story of the firm in an excellent little book entitled "Piccadilly Bookmen." Both in 1803 and 1804 John Hatchard was busily occupied

FIGURE 317.
The Knightian Medal of the Royal Horticultural Society.

in producing those broad-sheets which did so much to stimulate the popular hatred of "Little Boney" and the national resolve to resist his aggression to the death. The parlour at "Hatchard's" was now a place of rendezvous for ardent patriots and politicians as well as for the bishops and clergy of the Low Church Party, who had lately seceded from Rivington's house, at the sign of the Bible and the Sun in St. Paul's Churchyard. Scott, Crabbe and Sydney Smith were all habitués at "Hatchard's" and the latter, in 1810, commenced an article on "Public Schools" in *The Edinburgh Review* by observing that:—"There is a set of well-dressed prosperous gentlemen who assemble daily at Mr. Hatchard's shop, clean, civil personages well in with the people in power, delighted with every existing institution, and almost with every existing circumstance; and every now and then one of these personages writes a little book, and the rest praise that little book, expecting to be praised in their turn for their own little books, and of these little books thus written by these clean, civil personages, so expecting to be praised, the pamphlet before us appears to be one."

In the very next sentence Mr. Humphreys solves the historical doubt for which Mr. George Smith and Sir Trevor Lawrence are jointly responsible, for he says:—"While speaking of the place in the early days as a rendezvous, it may be appropriate to mention the fact that 'The Royal Horticultural Society' received its first definite foundation on the 7th March, 1804, at a meeting held here. Among those who thus met and inaugurated that flourishing Society were *John Wedgwood*, *Andrew Knight*, the Earl of Dartmouth, and Charles Greville. It is a matter of tradition, amounting almost to a certainty, that a room now used for despatching orders was once a private parlour set aside for such gatherings as met when the Horticultural Society was first started."

It is a curious coincidence that in 1804 the Empress Josephine (as keen a lover of garden-craft as Lady Banks) was arranging for the importation of seeds and rare plants from the country her husband was threatening to invade and annihilate. It may also be noted that the next social movement to be set going at Hatchard's was the "Oretinian Society," which was in reality the primitive inception of a matrimonial agency.

FIGURE 318.
The Flora Medal of the Royal Horticultural Society.

Four of the early medals of the Royal Horticultural Society are now reproduced. The medal presented to Sir Christopher Hawkins, Bart., on 5th March, 1816 (see Figures 320 and 321), and the Sir Joseph Banks (see Figure 319), belong to that year, although the reverse of the former bears the date of the foundation of the Society, viz., 1804, with the words *Alienis mensibus aestas*. The Thomas Andrew Knight medal (see Figure 317) and the later Royal Horticultural Society's Flora medal, designed by Wyon (see Figure 318), are dated 1836. Other associations connected with

FIGURE 319.
The Banksian Medal of the Royal Horticultural Society.

FIGURE 320.

Large Medal presented to Sir Christopher Hawkins, Bart., on the 5th of March, 1816. Obverse.

garden craft soon came into existence, of which one of the best known and most successful was the South London Floricultural Society (see Figures 322 to 324).

The prosperity and practical usefulness of the Royal Horticultural Society may be said to have commenced from the very year of its

FIGURE 321.

The reverse of the Medal presented to Sir Christopher Hawkins, bearing the motto *Alienis mensibus aestas.*

FIGURE 322.

Obverse of a Medal of the South London Floricultural Society.

FIGURE 323.

A Medal of the South London Society after it had obtained the title of Royal.

FIGURE 324.

Reverse of the Medal seen in Figure 322.

foundation. "From the very beginning," says Mr. George Smith, "it justified its existence, and it remains to-day one of the most splendid legacies of that awakening period." Sir Joseph Banks, an indefatigable reader of papers at the evening meetings, had no longer any need to write (except jocularly)—"my gardener, who is also my master." One of the best remembered of these essays was that dealing with the practice of mulching strawberry plants with straw. Another was devoted to the cultivation of the American cranberry at Spring Grove. Thomas Andrew Knight, the learned author of the "*Pomona Herefordiensis*," who succeeded Lord Dartmouth as President of the Royal Horticultural Society, was an intimate friend of Sir Joseph Banks. His letters on gardening form an important section of the Banks correspondence preserved at South Kensington. On New Year's Day, 1826, George Cruikshank, having done with "Little Boney" and Queen Caroline, seems to have turned his attention to the vigorous Royal Horticultural Society. Hence the caricature entitled "Exhibition Extraordinary" which figures as No. 1331 in G. W. Reid's list (1871), and as No. 1155 in that of Captain R. J. H. Douglas (1903). We are indebted to Mr. Reid for some interesting identifications of early nineteenth-century adepts in the garden-craft and members of the Royal Horticultural Society. He writes:—"A meeting of the Horticultural Society with the company assembled, and described as part of the Exhibition, commencing with 'The Pink of Fashion, or Dandy Lion,' and ending with the 'Hortus Cantab, propagated at Newmarket.' The articles on the table have affinities to popular sensations and inventions. A volume of the Society's *Transactions* is lying open on one of the seats, where is an essay on a radish, illustrated with a highly finished engraving. The pictures against the wall are those of Sir Joseph Banks and Lady Ann Monson. Amongst the persons present are: Mr. West, Alderman Cox, Mr. Rogers, Mr. Wilbraham, Mr. Richard Salisbury, Mr. Sabine, Mr. Elliott, Mr. Turner, Mr. Motheaux, Captain Maxwell, Dr. Henderson, Lord Verulam and Mr. Labouchere." The presence of Mr. T. A. Knight, who held the presidency of the Royal Horticultural Society down to the year of Queen Victoria's Coronation, seems to have again escaped the notice of the chronicler, who thus describes the work of an artist whose powers of satire were not less pungent than those of James Gillray and Thomas Rowlandson.

BRIEF NOTICES OF BOOKS.

The following books have been received since the last number of "KNOWLEDGE" went to press. Those of particular interest to our readers will be reviewed at length in due course.

Science of the Sea.—Prepared by the Challenger Society. Edited by G. HERBERT FOWLER, B.A., Ph.D., F.L.S. 452 pages. 217 figures. 8 charts. 8-in.×5½-in.

(John Murray. Price 6/- net.)

This is a collection of essays by various writers, which will be of great use to those who have spare time on board ship, or who wish to take up oceanic work for its own sake.

The House Fly.—By L. O. HOWARD, Ph.D. 312 pages. 40 illustrations. 8½-in.×5½-in.

(John Murray. Price 6/- net.)

We have already waked up in England to the fact that flies are great carriers of disease, and a simple and straightforward book dealing with the subject will prove of great use to those whose responsibilities cause them to be interested in the matter, while it is hoped that it will bring home to others the truth of what perhaps they would otherwise consider to be a doubtful rumour.

Bees Shown to the Children.—By ELLISON HAWKS. 120 pages. 39 plates. 6¾-in.×4¾-in.

(T. C. & E. C. Jack. Price 2/6 net.)

This book is well calculated to interest children. The pictures will no doubt encourage them to study the insects dealt with at first hand.

Cambridge County Geographies.—Dumfriesshire.—By JAMES KING HEWISON, M.A., D.D. 176 pages. 59 illustrations, 4 maps. *Renfrewshire.*—By FREDERICK MORT, M.A., B.Sc., F.G.S. 177 pages. 55 illustrations, 8 maps. *Perthshire.*—By PETER MACNAIR, F.R.S.E., F.G.S. 180 pages. 72 illustrations, 5 maps. 7½-in.×5-in.

(The Cambridge University Press. Price 1/6 each.)

We have already commented favourably on some of the earlier volumes in the series entitled Cambridge County Geographies. As is usual, a number of interesting facts not found in ordinary geographies are included: such as details of the people, the industries, antiquities, and natural history of the county, as well as its roll of honour. In the book on Dumfriesshire are mentioned Sir William Jardine the naturalist, Kirkpatrick Macmillan who invented the first gear-driven bicycle, and Sir John Richardson who went with Franklin to the polar regions as surgeon and naturalist. Renfrewshire can claim James Watt, while Perthshire has but few scientific worthies.

The Gateways of Knowledge.—By J. A. DELL, M.Sc. (Vict.). 171 pages. 51 illustrations. 8-in.×5½-in.

(The Cambridge University Press. Price 2/6.)

This is essentially a book of practical work and particularly to be commended.

Further Researches into Induced Cell-Reproduction and Cancer.—By H. C. ROSS, M.R.C.S. 125 pages. 9 illustrations. 9-in.×5¾-in.

(John Murray. Price 3/6 net.)

This contribution to the subject is concerned with the theory that cell-proliferation and possibly cell-development are directly brought about by chemical agents set free by cell-death.

Johnston's Handbook to the Celestial Globe.—32 pages. 7¼-in.×5-in.

(W. & A. K. Johnston. Price 1/-.)

This book is intended to accompany Johnston's Celestial Globes, and gives much information and suggests a number of problems which can be solved by the celestial globe, such as the finding of the sun's declination for any given day or the beginning, end and duration of twilight at any given place on any given day.

The People's Books.—The Foundations of Science.—By W. C. D. WHETHAM, M.A. 94 pages. 2 illustrations. *Inorganic Chemistry.*—By PROFESSOR E. C. C. BALY. 96 pages. *Radiation.*—By P. PHILLIPS, D.Sc. 94 pages. 34 illustrations. *Lord Kelvin.*—By A. RUSSELL, M.A. 94 pages. 1 illustration. *Francis Bacon.*—By PROFESSOR A. R. SKEMP. 94 pages. 1 illustration. *A Dictionary of Synonyms.*—By AUSTIN K. GRAY, B.A. 91 pages. 6½-in.×4¼-in.

(T. C. & E. C. Jack. Price 6d. net each.)

For the price of a monthly magazine those who are interested in science and scientific workers can buy a book by a well-known man which is convenient to carry about. Everyone should read the lives of Bacon and Kelvin, and while the volumes on various sciences can be picked out as the taste of the reader lies, others such as the one on Synonyms are generally useful as books of reference.

Laboratory Test Cards. 1st, 2nd, and 3rd year.—By JOHN HON, M.A., B.Sc., and HUGH JAMIESON. 6-in.×4¾-in.

(The University Tutorial Press. Price 1/- net each year.)

These, as the name states, are cards, and contain practical instructions for three years' work, to which are added other cards giving answers and hints. The first year deals with measurement and matter, the second with heat and the third with chemistry.

We give the first paragraph of instructions from the third year. "Describe what happens when the powder given you is heated in a glass tube, test any gas evolved with litmus, lime water, glowing splinter, a lighted taper, and note all that happens." In the card of hints, we find that potassium chlorate and nine other substances are suggested for this experiment.

A Laboratory Notebook of Physics.—By S. A. MCDOWALL, M.A. Section 1:—Measurement and Hydrostatics. 20 pages. Section 2:—Heat. 62 pages. Section 3:—Light. 112 pages. Section 4:—Magnetism, Electrostatics, Current Electricity. 166 pages. 9¼-in.×7-in.

(J. M. Dent & Sons. Price—1 9d.; 2, 3 & 4, 1/- net.)

Many good teachers know how important it is to furnish their students with practical instructions, which should be inserted in a notebook side by side with drawings or other records of the experiments or investigations suggested. No doubt sheets specially prepared for each lesson and coming fresh to the students are the best, but many teachers have no time to spend in getting ready their work in this way, and Mr. McDowall's instructions have the advantage of being printed in the actual notebooks.

The Physiology of Protein Metabolism.—By E. P. CATHCART, M.D.—142 pages. 9¾-in.×6-in.

(Longmans, Green & Co. Price 4/6 net.)

This monograph consists of a discussion of the more important results published during the last decade, and their bearing upon the work of the early investigators.

Romance of Science Series.—Chemical Research and National Welfare.—A lecture delivered by Professor EMIL FISCHER. 80 pages. 7-in.×5-in.

(The Society for Promoting Christian Knowledge. Price 1/6.)

It is useful for the general public to be reminded of what science does for the community; for as soon as a discovery is put to practical use it seems almost always to be looked upon as part of commerce. We hope that this book on chemical research will be followed by others dealing with our indebtedness to different sciences.

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Preventable Cancer. A Statistical Research.—By ROLLO RUSSELL. 167 pages. 7¾-in.×5¼-in.

(Longmans, Green & Co. Price 4/6 net.)

The author has collected together statistics dealing with cancer which cannot fail to be of interest and value. The freedom from cancer of monasteries, where the diet is simple, is one of the interesting points touched upon.

Text-Books of Physical Chemistry. — Edited by SIR WILLIAM RAMSAY, K.C.B., F.R.S. *Spectroscopy.* — By E. C. C. BALY, F.R.S. 687 pages. 180 illustrations. 7½-in.×5-in.

(Longmans, Green & Co. Price 7/6 net.)

The first edition of this book appeared in April, 1905, and the fact that a new one has been called for shows how useful the work has been found.

Fungoid Diseases of Agricultural Plants.—By JAKOB ERIKSSON, Fil.Dr. 208 pages. 117 illustrations. 8¼-in.×5¾-in.

(Baillière, Tindall & Cox. Price 7/6 net.)

The number of fungoid pests to which cultivated plants are liable is so great, and their effect so far-reaching, that all contributions to the subject will be welcome. The manuscript of the English edition of Dr. Eriksson's book has been read through by Mr. George Massee, so that the technical terms may be relied upon.

Report on the progress and condition of the U. S. National Museum for the year ending June 30th, 1911.—147 pages. 9¼-in.×6-in.

(Smithsonian Institute.)

The report records that the new building was finished on June 20th, 1911, six years after it was begun, and deals also with its occupation, in addition to the usual accounts as to what has happened in the various departments.

Oil Finding.—By E. H. CUNNINGHAM CRAIG, B.A., F.G.S. With an introduction by SIR BOVERTON REDWOOD, Bart. 195 pages. 13 plates. 18 figures. 9-in.×5¾-in.

(Edward Arnold. Price 8/6 net.)

This book, it is anticipated, will be of use to those who are about to invest in petroleum undertaking, or who are shareholders in petroleum projects which are of an exploratory nature.

Nature Study Notebook.—By GEORGE H. GREEN. 63 pages. With many illustrations. 6¾-in.×4¼-in.

(J. M. Dent & Sons. Price 6d. net.)

This small book is one of the Educational Journey Series, and is presumably intended to bring before the notice of town children some of the matters with which they will meet on their rambles. A few common animals are described, details are given of plant associations, while the sixth chapter tells something about agriculture and agricultural processes.

A Handbook of Nursing.—By M. N. OXFORD. 319 pages. 7½-in.×5¼-in.

(Methuen & Co. Price 3/6 net.)

This is the sixth edition of a book which first saw light in 1900.

In Light and Darkness—Hope! — By IRENE E. TOYE WARNER. 80 pages. 5¾-in.×4½-in.

(Kegan Paul, Trench, Trübner & Co. Price 1/6.)

This little book of verses by Miss Toye Warner, known to our readers as an astronomer, is dedicated to another of our contributors, Mr. W. F. Denning.

Spiders.—By CECIL WARBURTON, M.A. 136 pages. 13 illustrations. *Rocks and their Origin.*—By G. A. J. COLE. 175 pages. 19 illustrations. *The Origin of Earthquakes.*—By C. DAVISON, Sc.D., F.G.S. 144 pages. 26 illustrations. 6¾-in.×5-in.

(The Cambridge University Press. Price 1/- net each.)

Mr. Warburton's book occupies itself with the habits of spiders, with the spinning of webs, with gossamer and water spiders, as well as those which jump and seize their prey.

Those who know Mr. Grenville Cole's writing will welcome his contribution on rocks and their origin, while readers of "KNOWLEDGE" interested in Earthquakes will recall Dr. Davison's contributions to our columns, and we are glad to hear more about the phenomena in question.

We have also received the following books:—

Algebra for Beginners. With Answers.—By C. GODFREY, M.V.O., M.A., and A. W. SIDDONS, M.A. 272 pages. *Examples in Numerical Trigonometry.*—By E. A. PRICE. 90 pages. 38 illustrations. *Numerical Trigonometry.*—By J. W. MERCER. 157 pages. 61 illustrations. 7½-in.×5-in.

(The Cambridge University Press. Price 2/6, 2/-, 2/6.)

The Mineral Kingdom. Parts 21 and 22.—By Dr. REINHARD BRAUNS. Translated, with additions, by L. J. SPENCER, M.A., F.G.S. 8 pages 5 plates and 16 pages 5 plates respectively. 12-in.×9-in.

(Williams & Norgate. Price 2/- net each.)

Catalogue of 2,043 Stars between 35° and 37° S. Dec.—By W. ERNEST COOKE. 122 pages. 12¼-in.×10-in.

(Fred. W. Simpson, Perth, Australia.)

Astrographic Catalogue. 1900·0. Perth Section. Dec. −31° to −41°. Vol. I.—By W. ERNEST COOKE, M.A., F.R.A.S. 52 pages. 12-in.×9¾-in. Vol. IV. 72 pages. 12-in.×9¾-in.

(Fred. W. Simpson, Perth, Australia.)

NOTICES.

THE HAMPSTEAD SCIENTIFIC SOCIETY.—From the Annual Report for the year 1911 it is evident that the Hampstead Scientific Society is doing excellent work in astronomy, natural history, and photography, each of which is dealt with by a separate section, as well as through the meetings of the Society generally.

THE SEISMOLOGICAL SOCIETY OF AMERICA.—The current Bulletin of this society contains an interesting article on Professor John Milne, as well as a most useful paper on the choice of a seismograph, in which the many forms of the instrument are described and illustrated.

BOOKS ON LONDON.—We have received from Messrs. Sotheran & Company a beautifully illustrated catalogue of books and prints dealing with London and its neighbourhood, as well as social memoirs and diaries and some fine engravings, not to mention a series of one hundred and fifty pictures and caricatures dealing with fashions in head dress during the eighteenth and early nineteenth centuries.

SMITHSONIAN MISCELLANEOUS COLLECTIONS.—Volume LVII, numbers 6, 7 and 8, deal with Cambrian Geology and Palaeontology, Volume IX, numbers 4 and 5, with new genera and species of hymenoptera and microlepidoptera, respectively, from Panama.

NOTICE OF REMOVAL.—Owing to the rapid increase in the Manufacturing Branch of their business, Messrs. Isenthal & Company have now removed the whole of their Works and Offices to the Factory at Denzil Road, Neasden, to which address all correspondence should now be directed.

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